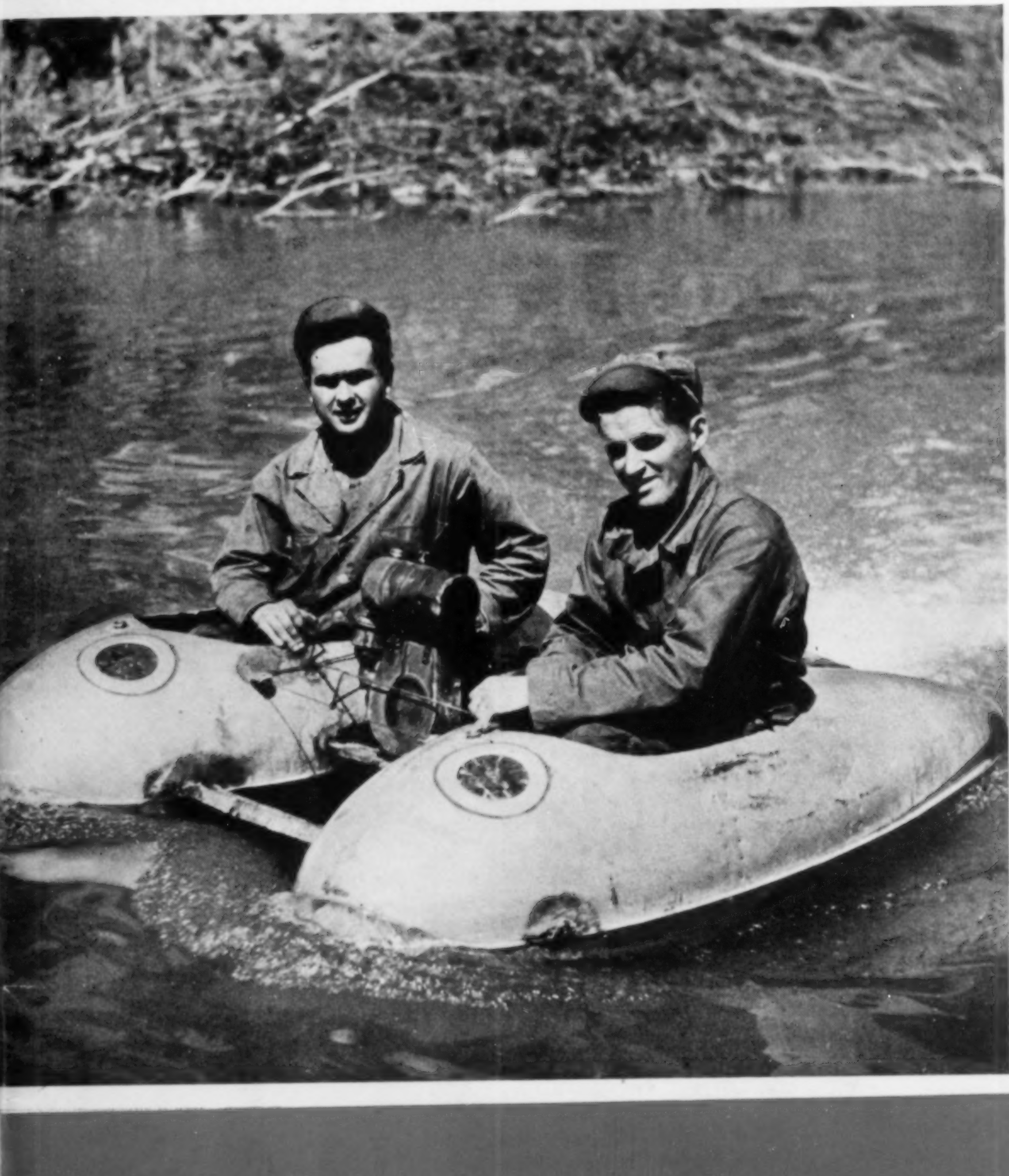
Compressed Air Magazine

AUGUST 1945



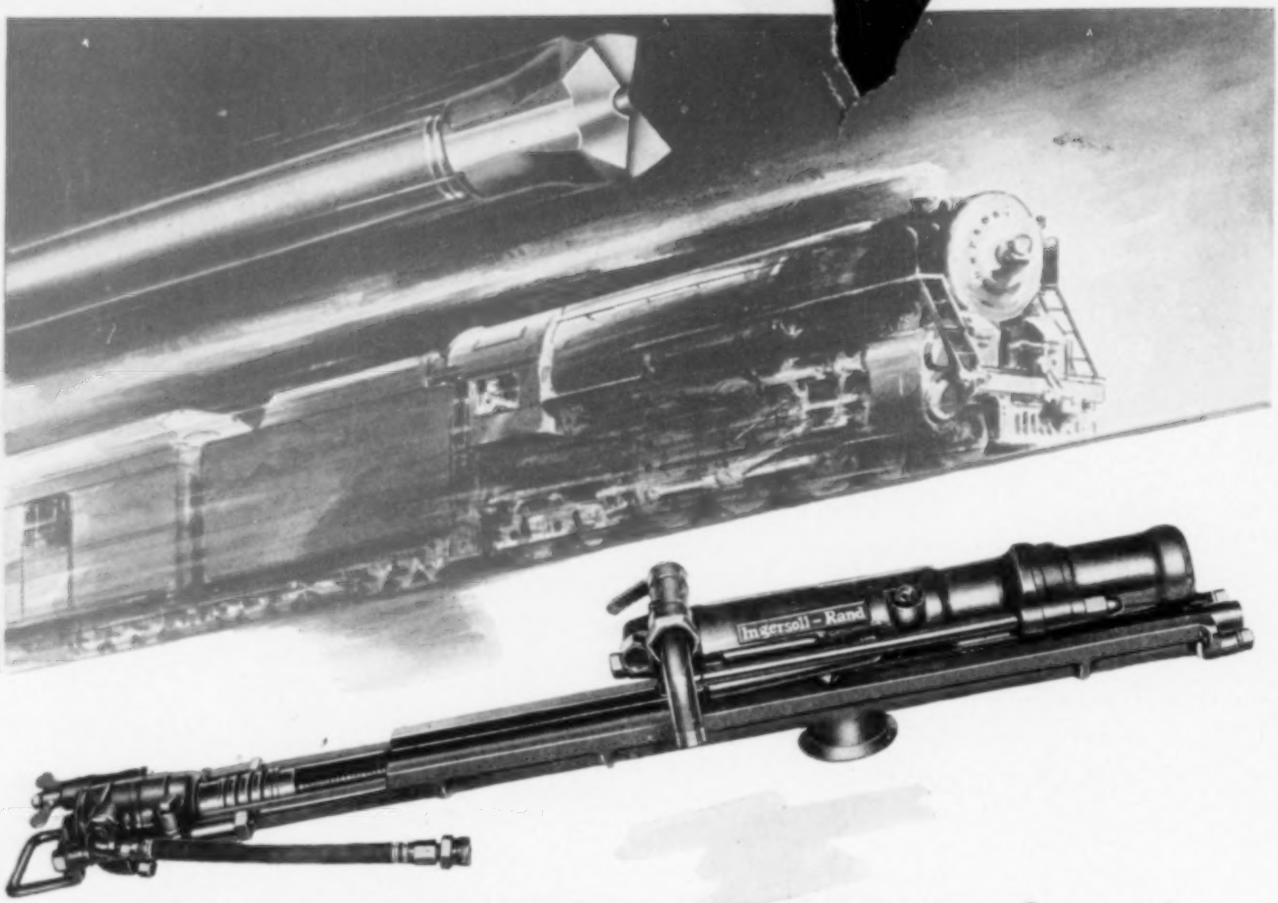
SALVAGE-PILE
G. I. MOTORBOAT

Craft built of airplane gas tanks propelled by engine from compressor

Official Photo U.S.A.A.F.

VOLUME 50 · NUMBER 8

NEW YORK · LONDON



DA-35 ROCK DRILLS *Speed*

completion of 3015-ft. Tunnel to aid wartime freight-haulage problem

The transportation of war materiel and fighting men must be fluid. Loads must be heavier. There can be no bottlenecks. That is why the Northern Pacific Railway drove a new 3015-foot tunnel in the mountains of Montana.

The old tunnel, built in 1886, restricted the size of loads . . . there was not enough clearance for the big Mallet-type locomotives. The new tunnel, driven directly alongside the old one, has sufficient cross-section to handle today's tremendous freight trains.

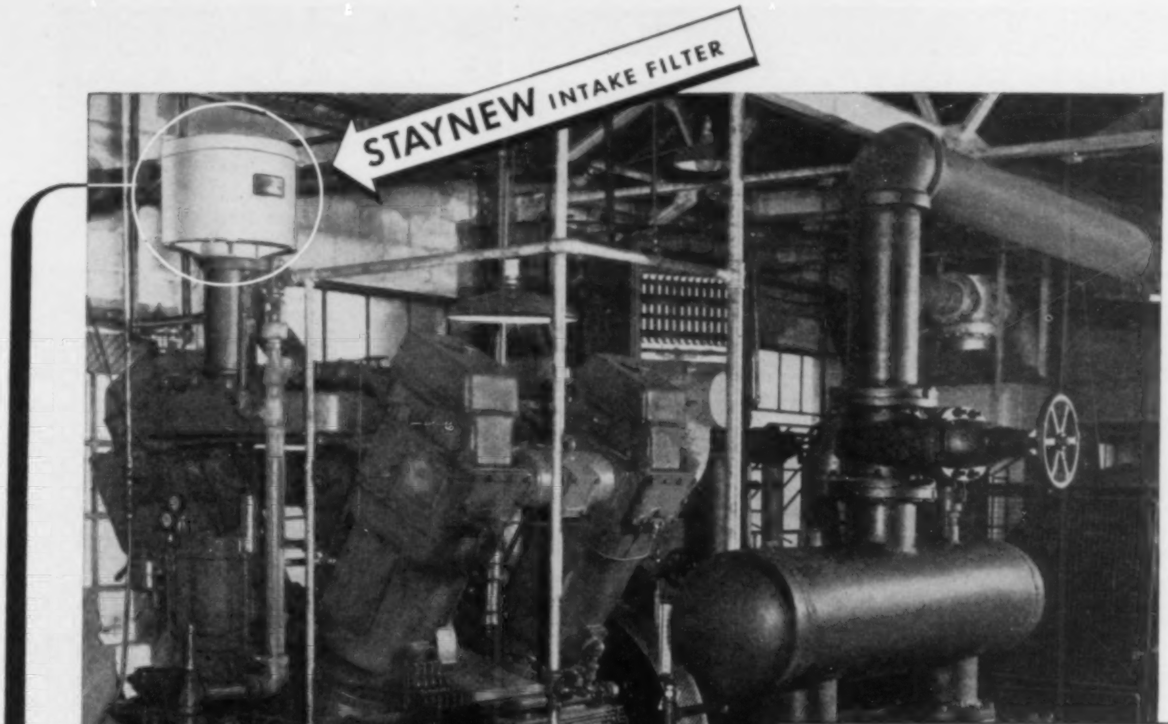
This work had to be done without delaying movement of wartime freight and passengers. A regular operating cycle could not be used—blasting was controlled by the train dispatcher. Good organization and efficient use of equipment, however, made up for the loss of construction time caused by heavy train schedules. DA-35 Power-Feed Drifters were selected for the drilling. Here, as in many tunnels and mines throughout the country, the record-breaking drilling speed and durability of these machines helped push the job to speedy completion.

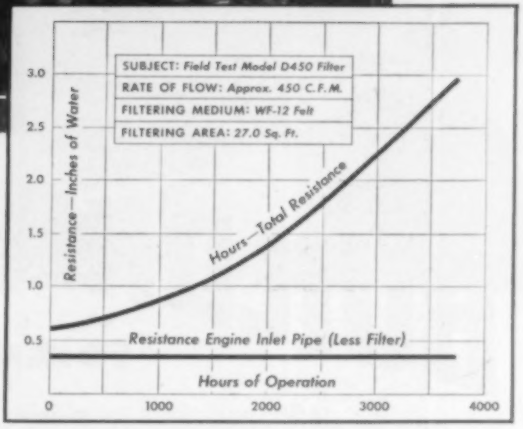
In these trying days of manpower shortage and lack of skill, the inherent high drilling speed and sound design of DA-35 Power-Feed Drifters will help your men drill more feet of hole per shift. Your Ingersoll-Rand Branch can show you why.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

5-678

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES





3761 HOURS CONTINUOUS OPERATION WITHOUT ATTENTION

Yet Filter Resistance Is Only 2.73 Inches of Water

This filter, installed on a Diesel-powered compressor, operates under unusually severe conditions. Intake air is heavily loaded with dust and oil; the dust due to the close proximity of a railroad siding where bulk lime, sand, and coal are handled—the oil to two additional Diesel-powered compressors operating in the same room.

Such a case history is not unusual. Reports are frequently received of Staynew Filters operating under less severe conditions for two or more years without attention—with the initially high efficiency rising as dust load increases.

Ease of cleaning as well as infrequency of cleaning is also an important feature, requiring only a few minutes with the specially designed Staynew Cleaning Nozzle.

More and more experienced operators of compressor and engine equipment specify Staynew Intake Filters—not only because of the minimum attention required, but also because these filters:

- ★ **Provide positive protection**
- ★ **Require no pre-coat or filter aid**
- ★ **Are unaffected by extremes of temperature**
- ★ **Permit use of oversize filters (air velocity not critical)**
- ★ **Are ideal for use with carbon ring compressors**

STAYNEW PROTECTOMOTOR FILTERS

DOLLINGER CORPORATION

(Formerly Staynew Filter Corporation)

7 CENTRE PK., ROCHESTER 3, N.Y.

Representatives in Principal Cities

Silver ANNIVERSARY 1920-1945

American industry flows through fairbanks valves

BUILDING...

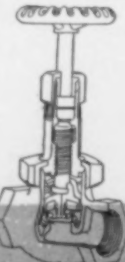
tomorrow's wakening giant

After war's final "cease-firing", look for the building industry to go places . . . for vast cities-within-cities to take shape. They're on drafting boards today.

Air conditioning and ventilating will be widened to include removal of dust, bacteria and odors from the atmosphere by unit-type air sanitation equipment. On the upswing will be radiant heating, zoned heating, service hot water, spot cooling units . . . gas air conditioning which regulates humidity . . . a single heat pump system which heats buildings or cools them as desired.

Controlling liquids and gases in miles-on-miles of tomorrow's piping will be thousands and thousands of Fairbanks Valves. They will have been selected because of topflight past performance . . . because architects and engineers know they can expect freedom from failure when a Fairbanks is installed.

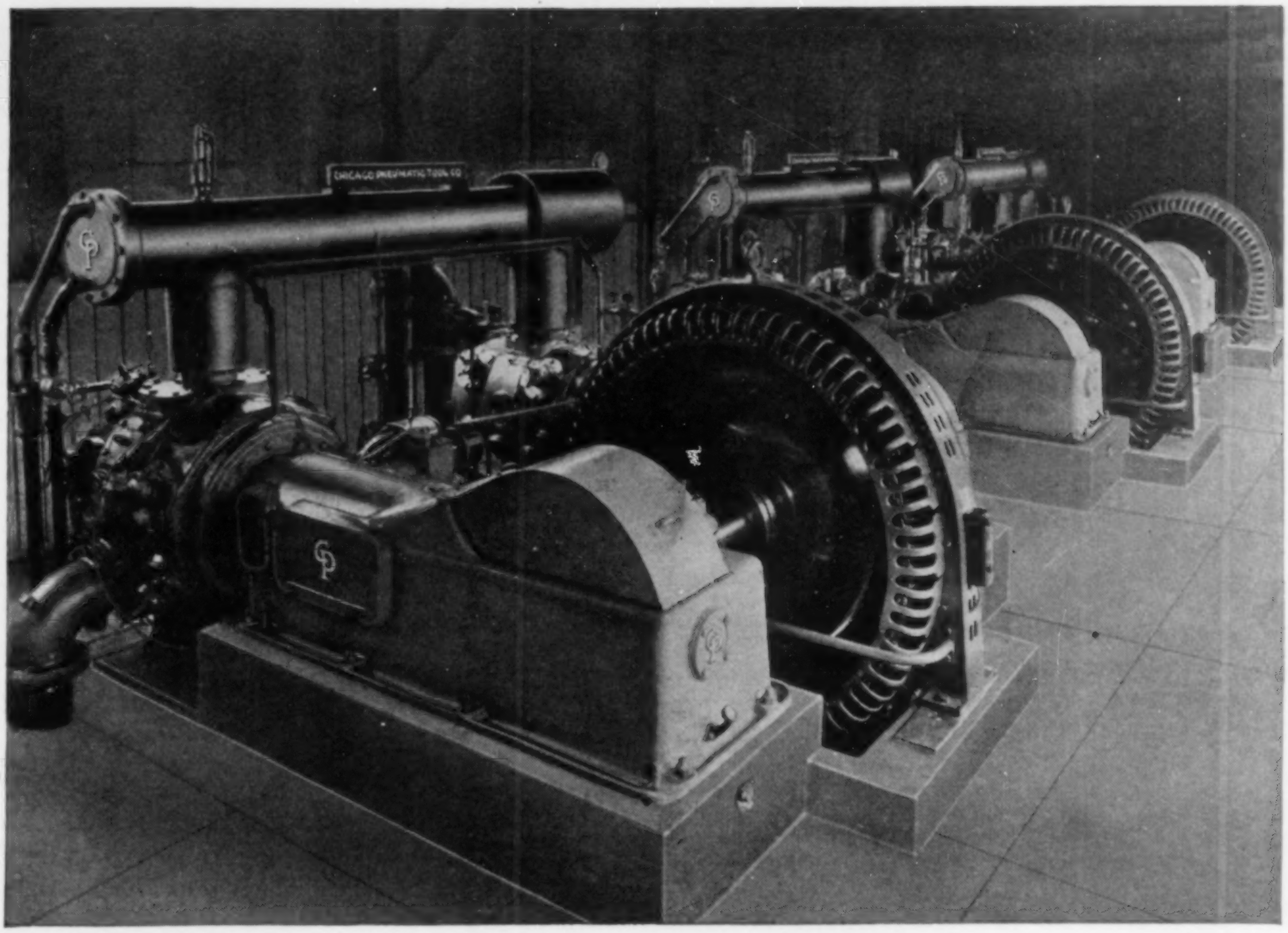
Whether it's a small bronze valve or a huge iron body gate valve with a 24-inch opening the name Fairbanks stands for sound engineering, careful chemical and metallurgical control of alloys, ample metal for the job. The full line is given in catalog "42" which will be sent you if you ask for it. If you need special assistance with individual problems of valve selection and application, call on the facilities of the Fairbanks Engineering Department.



THE fairbanks COMPANY

393 LAFAYETTE STREET, NEW YORK 3, N. Y.

520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.



VALVES THAT OPEN WIDE ...SHUT TIGHT

WHEN air compressors are operating efficiently, valves open wide and shut tight, piston rings stay free in their grooves, ports are open, air lines clear. Effective lubrication—*Texaco*—assures you all these benefits.

Texaco Alcaid, Algol or Ursa Oils keep compressors free from gum, sludge and hard carbon, assure continuous, full-power air supply. Their use means maximum service life between overhauls, fewer repairs and replacements—*better performance at lower cost!*

Because they have proved so effective in service, Texaco lubricants are definitely preferred in many fields.

Texaco Lubrication Engineering Service is available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO REG. T. M.

TEXACO Lubricants

FOR ALL AIR COMPRESSORS AND TOOLS

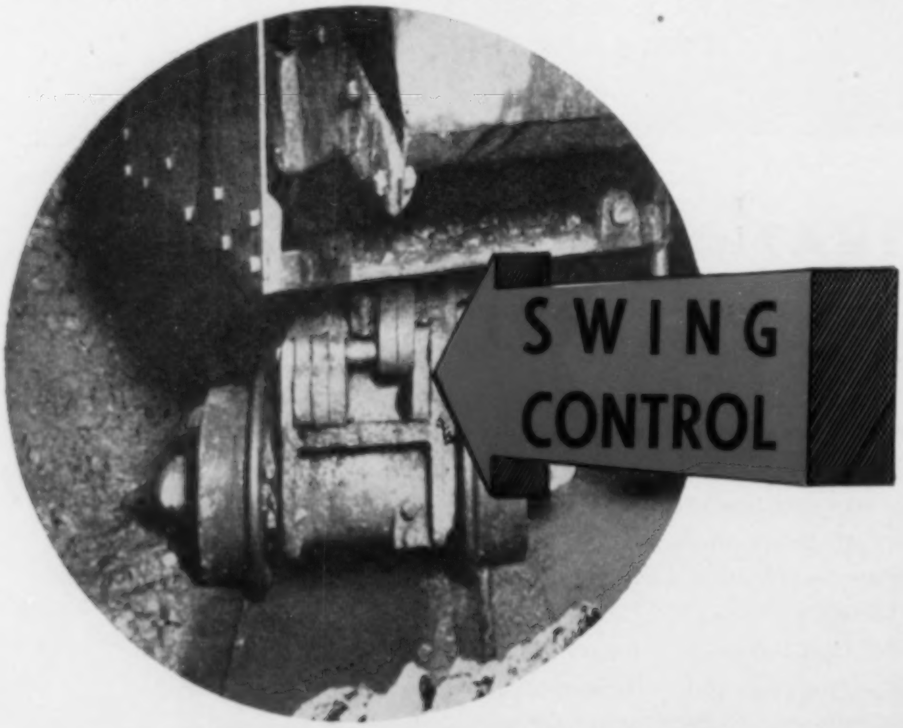
TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—CBS

RockerShovel

Multi-Step

This patented RockerShovel feature permits swinging of upper deck and Rocker arm assembly to desired limits — prevents digging into or knocking down timbered sets or catching bucket on back of narrow drifts. "Swing control" makes possible faster loading and provides a positive speedy adjustment to existing underground conditions.

A series of movable stops may be engaged instantaneously to permit a limited swing on both sides or on either side independently of the other. Digging width can be controlled to suit drift conditions as shown in the illustration.



No need to move tracks to center of drift—the operator used the "swing control" to limit the movement on the side near timber sets and used the full swing on the opposite side.

A simple device, exclusive to RockerShovels, that prevents lost time underground and speeds up production.

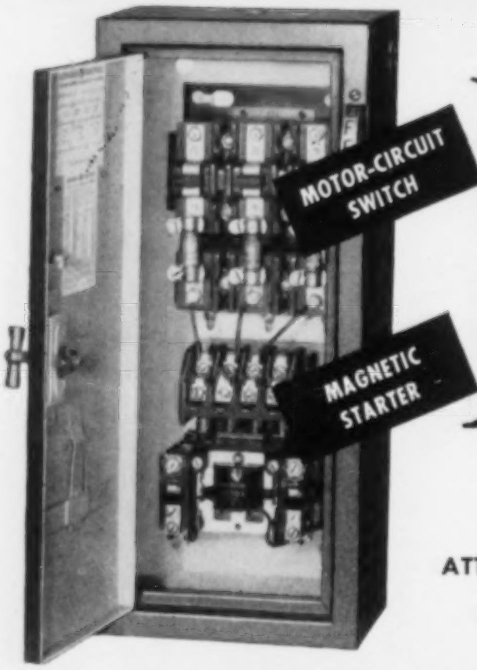
Swing Control

EIMCO

THE EIMCO CORPORATION

Executive Offices and Factories: Salt Lake City 8, Utah
Branches: New York, Chicago, El Paso, Sacramento, St. Louis

MOTOR STARTERS EVERY TYPE, EVERY SIZE, FOR EVERY MACHINE APPLICATION



COMBINATION STARTERS

DEPENDABLE . . .
ATTRACTIVE IN APPEARANCE . . .
DESIGNED TO BLEND WITH MODERN MACHINES

Advantages of Combination Starters

1. ***50% reduction in mounting time***—You mount only one device, not two.
2. ***40% reduction in wiring time***—Connect to only 9 terminals, not 15. The switch and starter come connected.
3. ***Sure safety***—Cover cannot be opened while power is on the starter.
4. ***Reliable motor protection***—Protection devices co-ordinated at factory.
5. ***Saving of wall space***—The one device takes less space than two.
6. ***Improved plant appearance***—Single, streamlined case; less open wiring and conduit.

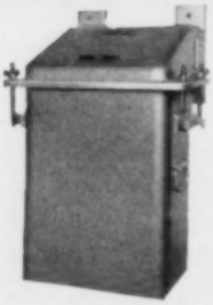
Whatever your plant's operating condition, you can get a suitable G-E combination control. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one compact, easy-to-mount unit.

Write today for more information about these combination starters. Our engineers will be glad to help you select just the right starter for your application. *General Electric Co., Schenectady 5, N.Y.*

GENERAL PURPOSE

Suitable for general-purpose indoor applications where atmospheric conditions are normal.

CORROSION RESISTANT



Made for corrosive atmospheres and hazardous locations. All arcing parts and terminals (of forms for hazardous locations) are at least six inches under oil.

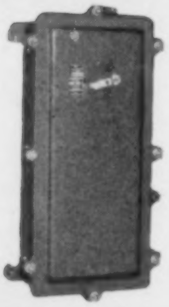
DUST-TIGHT

For use in steel mills, cement mills, and other locations where the dust content of the atmosphere is heavy.

FOR HAZARDOUS LOCATIONS

Designed to withstand internal explosions. The flanges are ground to tolerances which will not permit the escape of gases.

WATERTIGHT



Suitable for outdoor use, and for damp places indoors, such as dairies, breweries, and ship docks.

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

676-136C-8920

Lift YOUR LOADS *Lower* YOUR COSTS

Put an EASTON Tier-Lift truck on the job. Watch it give your materials a lift—watch your handling costs go down.

Powered by storage battery or gas-electric Ready Power in capacities up to 10,000 pounds. EASTON trucks are easy to operate, economical to maintain—they stay on the job.

EASTON builds the original Tier-Lift electric truck. Backed by 30 years of experience the Tier-Lift, Low-Lift—also Platform and special types—solve unusual jobs.

Write Engineering Counsel, Easton Car and Construction Company, Easton, Pennsylvania.

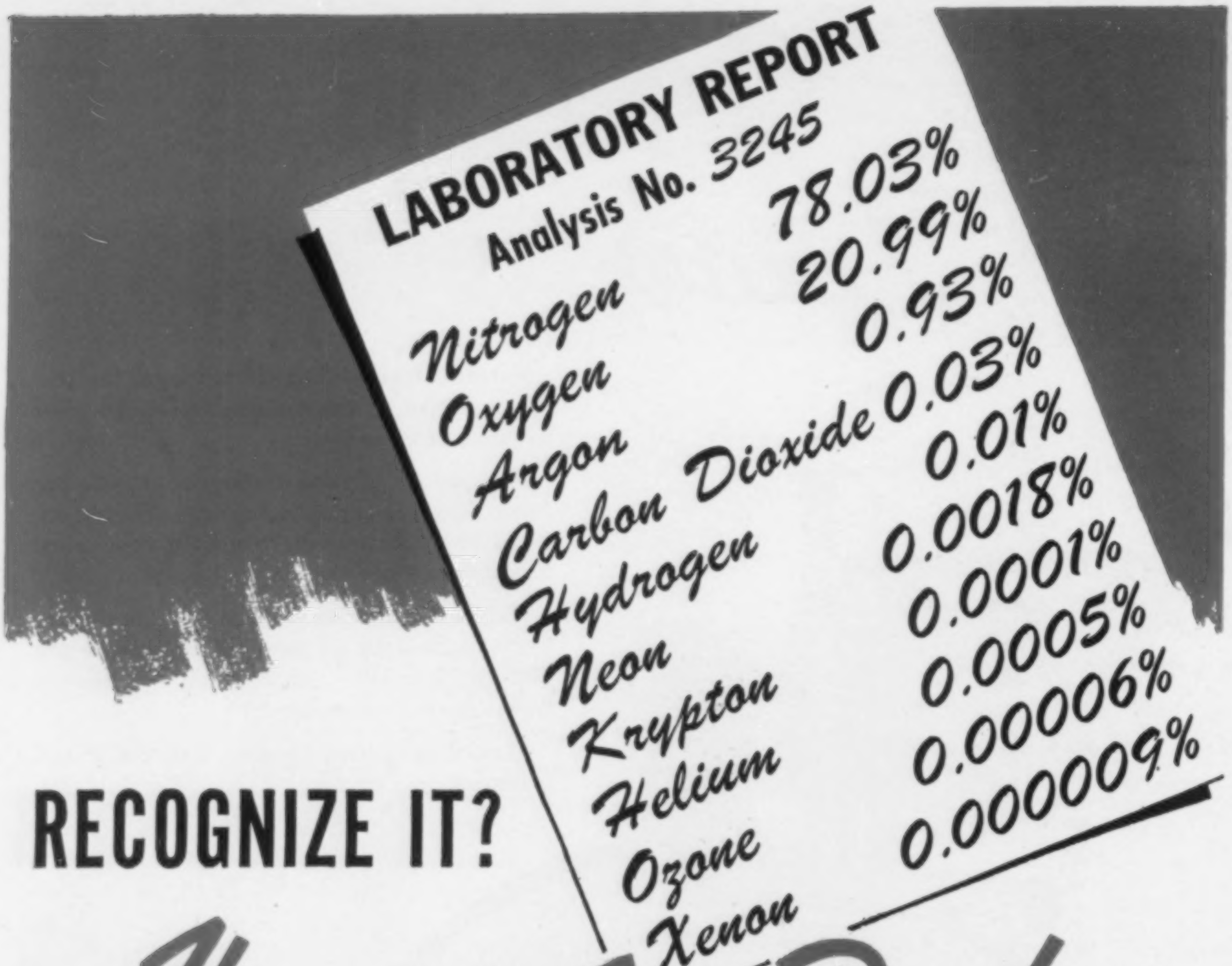
Model - TLC-6

Model - LL-6

Model - TLC-6

EASTON
INDUSTRIAL CARS
TRUCK BODIES · TRAILERS
ELECTRIC LIFT TRUCKS

A-1008



LABORATORY REPORT
Analysis No. 3245

Nitrogen	78.03%
Oxygen	20.99%
Argon	0.93%
Carbon Dioxide	0.03%
Hydrogen	0.01%
Neon	0.0018%
Krypton	0.0001%
Helium	0.0005%
Ozone	0.00006%
Xenon	0.000009%

RECOGNIZE IT?

You use it Every Day!

Of course you know, it's air—transparent, sound-carrying, flame-sustaining, life-supporting air. It is so obviously important to all of us that we are apt to forget that it is far more than a medium for airplane travel . . .

Industrially, too, the advantages of air power are apt to be overlooked—yet this hard fact remains: *More power can be transferred to hand-held tools with greater safety by compressed air than by any other method used today.* Think of that when next you plan to put *power* in the hands of a workman. Put compressed air at his disposal—give him powerful, light-weight air tools. You and he both will benefit by the faster production and reduced manual effort that invariably results.

Call upon Ingersoll-Rand whenever you have a job for air. We have specialized in air power machinery for more than 70 years, and have played no small part in the tremendous development of pneumatics during that period.

* * * *

Necessity is the mother of invention—need is the spur to thought. If the application of air power efficiency to *one new problem* is stimulated, this message will have served its purpose well.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

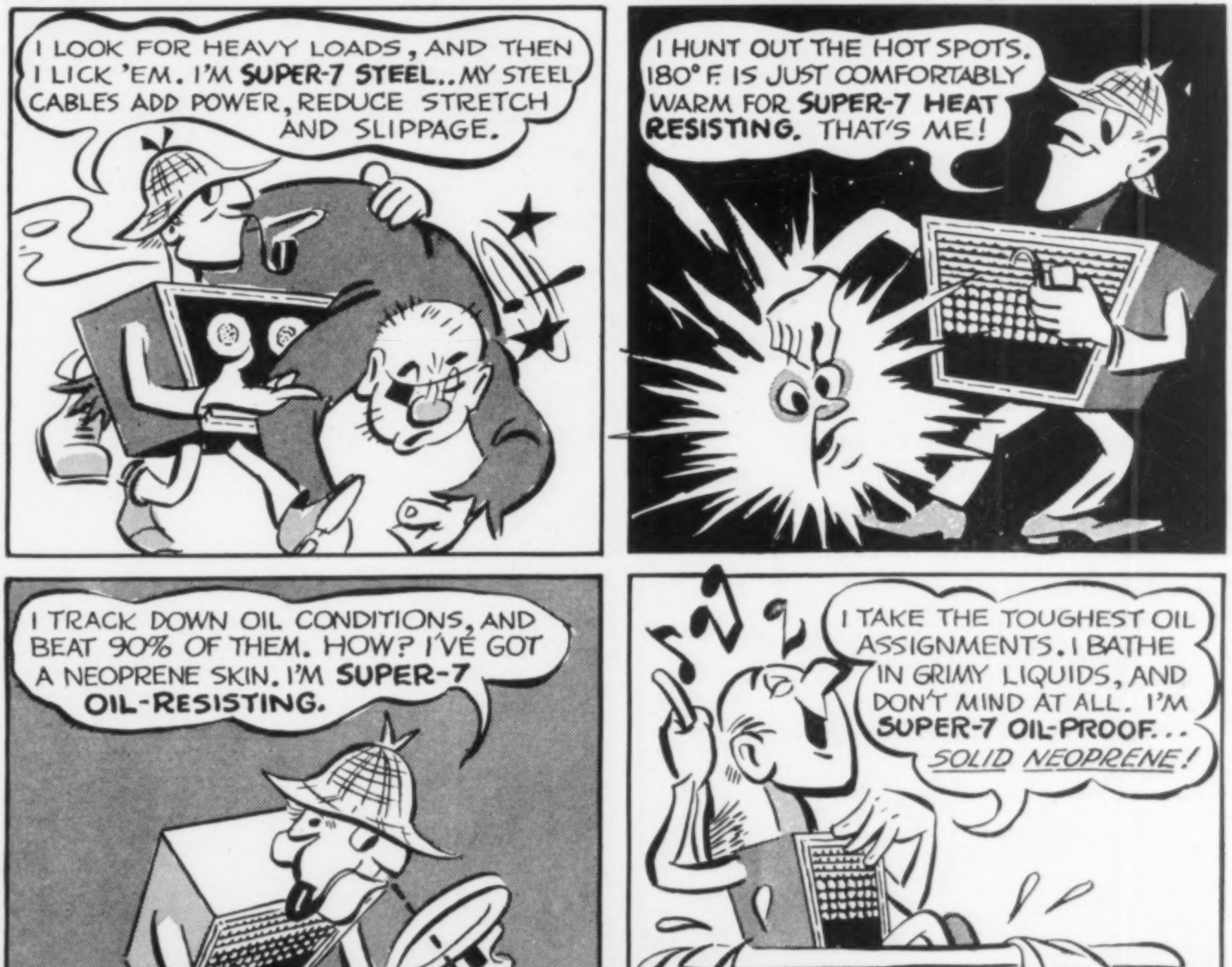
8-695

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

LOOKING for TROUBLE!

Designed to stand up in trouble spots, America's newest and widest line of V-belts — Allis-Chalmers' Texrope — solves every one of these drive problems

I FIND MY PLACE WHERE EXPLOSION IS A DANGER. I'M SUPER-7 STATIC RESISTING; MY BUILT-IN CONDUCTING ELEMENT CARRIES CHARGES TO THE MACHINE WHERE THEY'RE GROUNDED


I LOOK FOR HEAVY LOADS, AND THEN I LICK 'EM. I'M SUPER-7 STEEL.. MY STEEL CABLES ADD POWER, REDUCE STRETCH AND SLIPPAGE.
I HUNT OUT THE HOT SPOTS. 180° F. IS JUST COMFORTABLY WARM FOR SUPER-7 HEAT RESISTING. THAT'S ME!
I TRACK DOWN OIL CONDITIONS, AND BEAT 90% OF THEM. HOW? I'VE GOT A NEOPRENE SKIN. I'M SUPER-7 OIL-RESISTING.
I TAKE THE TOUGHEST OIL ASSIGNMENTS. I BATHE IN GRIMY LIQUIDS, AND DON'T MIND AT ALL. I'M SUPER-7 OIL-PROOF... SOLID NEOPRENE!
A 1862

IT PAYS TO MAKE **ALLIS-CHALMERS** YOUR

V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

AO
Ful-Vue
Safety
Goggles

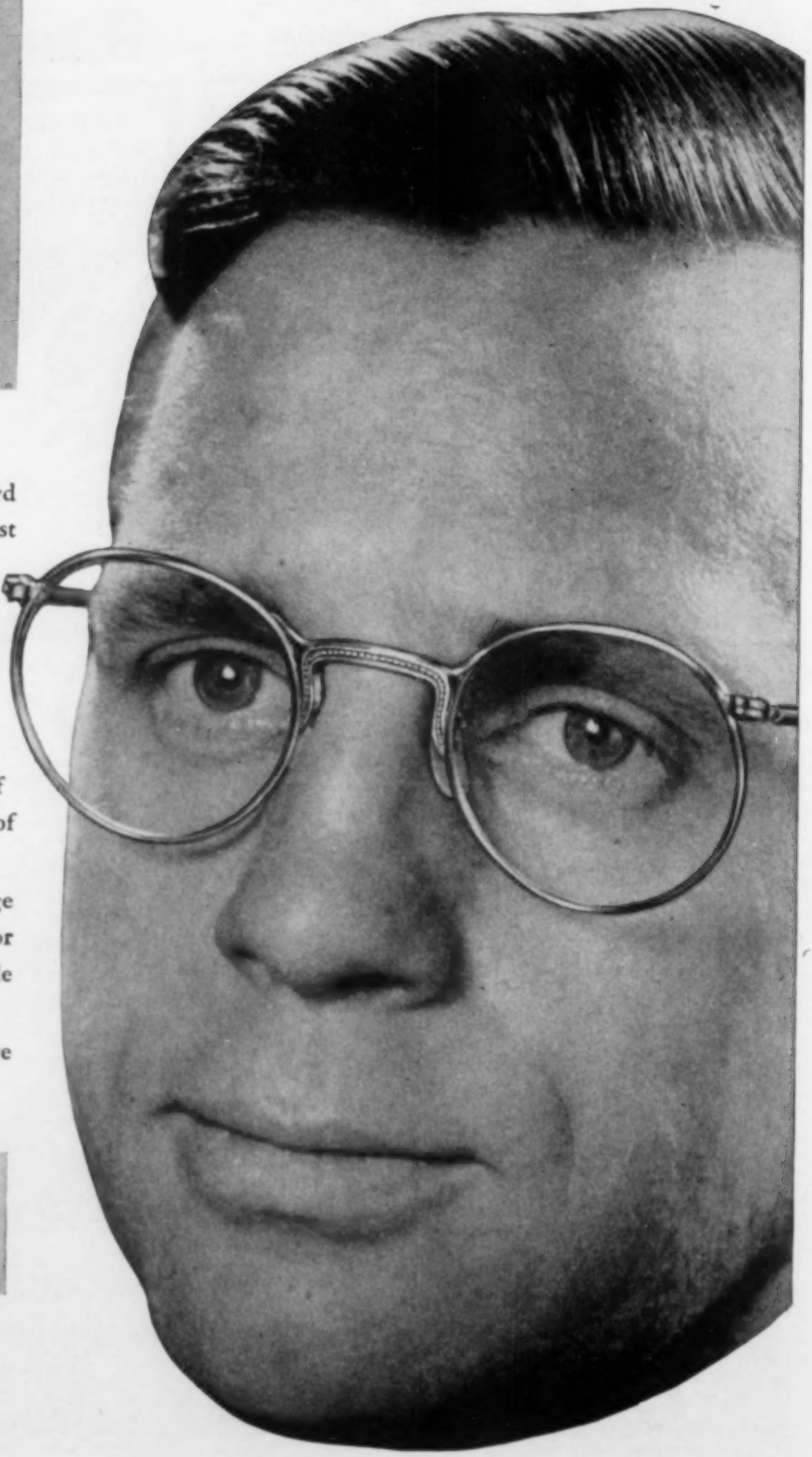
Eye Protection
plus Comfort and
Good Looks

AO Ful-Vue Safety Goggles afford efficient eye-protection with the greatest amount of all-angle visibility, comfort and good appearance. Sturdy, double-braced bridge designed for long life in strenuous service. Shape conforms to orbit of the eye; brings lenses closer for maximum protection; leaves no unprotected areas around bridge of nose. Earpieces have perspiration-proof insulation.

Made in three eye sizes and three bridge sizes, with Super Armorplate Clear or Calobar lenses—with or without side shields.

Your nearest AO Safety Representative can supply you.

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS



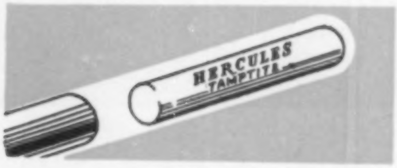
HERCULES
T·A·M·P·T·I·T·E

TAMPTITE MAKES LOADING EASY, SIMPLE, EFFECTIVE

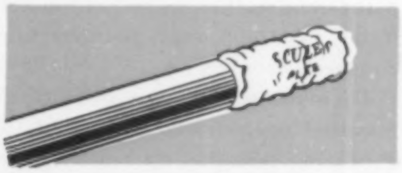
● The power of the dynamite is concentrated in the bore hole for maximum blasting effectiveness when you use Hercules patented Tamptite cartridges. Tamptite shells slide easily into the bore hole, and expand with slight pressure of the tamping rod to fill the hole tightly.

Tamptite cartridges conserve man-hours, eliminate completely the slitting of cartridges and loose, spilled powder around the working area. They give you better breakage, faster handling of materials, and, thus, increased output.

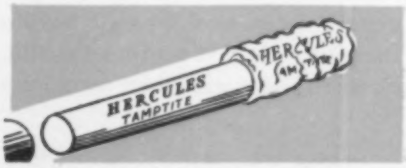
When ordering your favorite Hercules mining explosives, be sure to specify . . . "In Tamptite cartridges."



With Tamptite cartridges, the bore hole is loaded in the usual manner. No wasted time slitting cartridges.



The tamping rod packs the charge snugly in the hole, leaving practically no air space around the dynamite.



Continue inserting Tamptite cartridges and compressing them until the desired loading is achieved. This compact charge means better breakage, speedier mucking, a faster mining cycle.

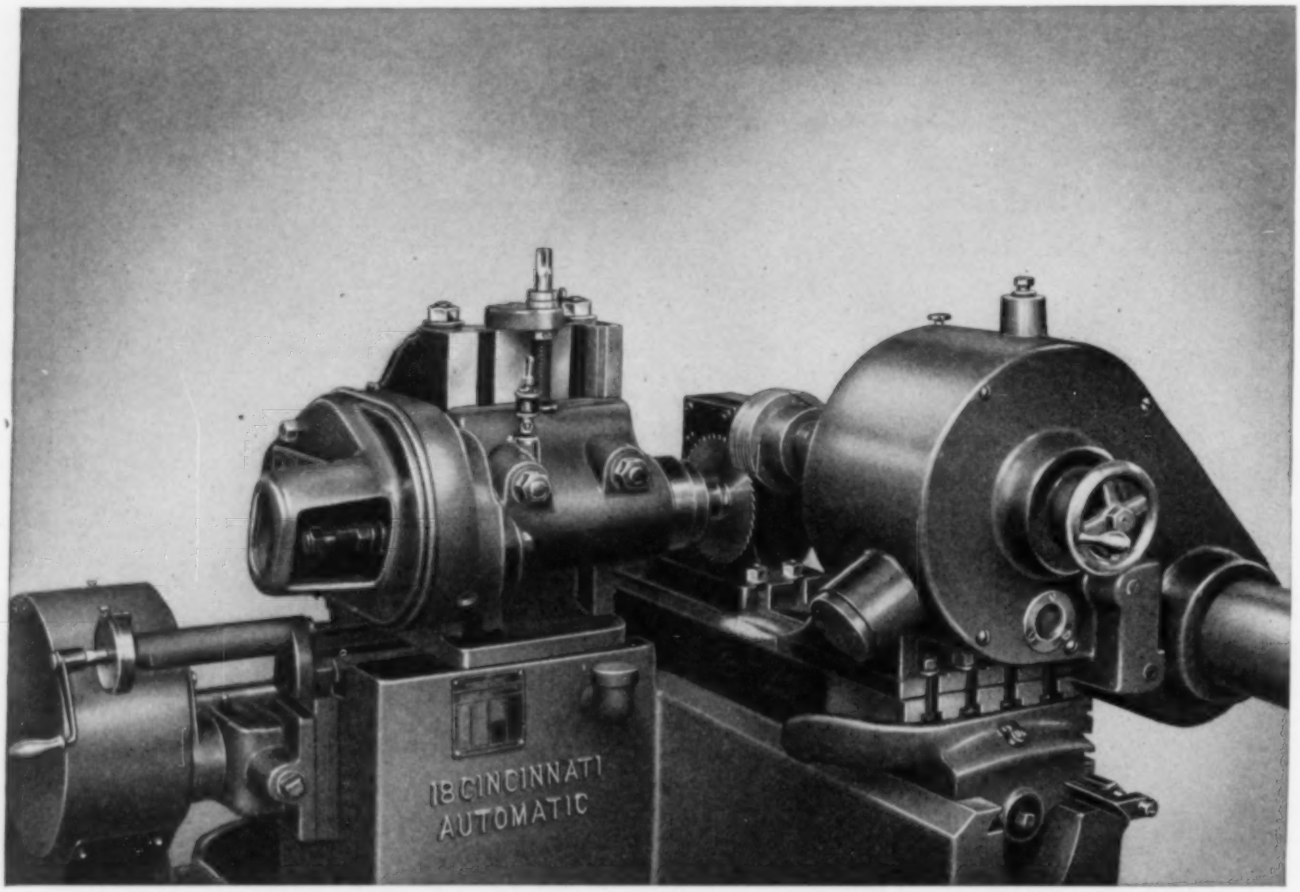
HERCULES

EXPLOSIVES DEPARTMENT, *HERCULES POWDER COMPANY* **932 KING STREET, WILMINGTON 99, DELAWARE**
INCORPORATED

®REG. U. S. PAT. OFF. BY HERCULES POWDER COMPANY

XR-51

MAKING PACKINGS ISN'T A JOB JUST ANYBODY CAN DO



MAKING PACKINGS for engines and compressors isn't a spare-time job for a handy man around the plant or a well equipped maintenance shop—even if they had the advantage of working from a France engineered blueprint.

To make packings worthy of the name France requires specialized equipment. Milling the tangents, for example, on France packing rings is the work of a machine especially built for us to do this operation. We also have *special* machines for turning and grooving, facing and boring, sawing and grinding cast iron, bronze, bakelite and carbon—the materials that go into metallic packings, even down to a special tool for machining the oil-dripper inside a case as well as a hundred and one "gadgets" for more efficient operation. There are in addition dozens of little tricks we've learned for making packings better and faster. It's about as hopeless to "home-make" a packing as to play a piano when you can't read a note. Remember these points when you specify or buy packings.

WARTIME MEMO TO SMALL COMPRESSOR BUYERS

Some compressors are equipped with soft packing. To reduce power consumption, eliminate rod wear, insure a positive seal for an indefinitely long period, *specify France Metallic Packing* when the compressor is ordered from the Engine Builder.

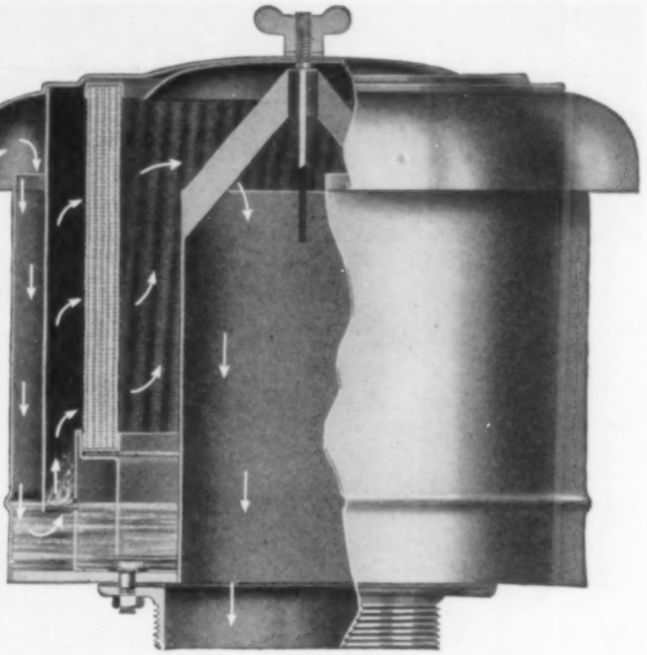
★ *FRANCE PACKINGS and PISTON RINGS* ★

FRANCE MFG. CO.

FRANCE MANUFACTURING COMPANY

E. A. France, President

Belgrade and Orthodox Streets, Philadelphia 37, Pa.



Oil Bath Filter
Patented

Air Filter QUIZ

1. HOW HIGH IS THE DUST ARRESTMENT? Practically all popular filters for air intakes of engines, compressors and blowers have efficiencies ranging between 95% and 99%. But there are other important considerations in the selection of an air filter.

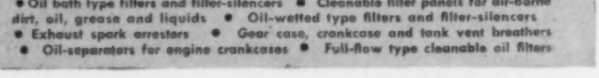
2. IS IT ALL METAL? All metal filters resist deterioration. Air-Maze all metal filters use a media of crimped metal screen mesh which does not "pack down", and density of media is the same throughout every square inch of filter surface. Metal filters are better able to withstand engine backfires.

3. DOES IT OPERATE ON THE VISCOUS-IMPINGEMENT PRINCIPLE? Air-Maze Filters do. They permit large air flow in small space and are not affected by moisture or oil-laden air.

IF IT USES AIR . . . USE

AIR-MAZE

ENGINEERED AIR FILTRATION



- Oil bath type filters and filter-silencers
- Cleanable filter panels for air-borne dirt, oil, grease and liquids
- Oil-wetted type filters and filter-silencers
- Exhaust spark arresters
- Gear case, crankcase and tank vent breathers
- Oil-separators for engine crankcases
- Full-flow type cleanable oil filters

4. IS IT AN OIL BATH TYPE? Most industrial applications demand the greater dirt-holding capacity and less frequent service of an oil bath filter. Air-Maze Oil Bath Filters vary in size from breather filters to large industrial units.

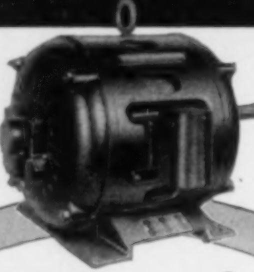
5. DOES IT HAVE LOW RESISTANCE TO AIR-FLOW? The advantage of low pressure drop is obvious. Because of the cylindrical design of Air-Maze Filters, the average drop in oil-wetted types is less than ⅛" w.g.; in oil bath types, less than 2" w.g.

6. CAN THE FILTER BE DISASSEMBLED AND CLEANED? A simple servicing operation restores oil-wetted filters to their original efficiency. The continuous washing action in oil bath filters keeps the filtering media clean and efficient. Air-Maze Oil Bath Filters are designed so that they can be easily and quickly disassembled and cleaned when necessary.

★ ★ ★

You get engineered filtration in every Air-Maze Filter. More than 3,000 Air-Maze products assure proper selection of the filter for special application. Your Air-Maze representative will recommend the best filter for your needs. Air-Maze Corporation, Cleveland 5, Ohio. Representatives in principal cities. In Canada: Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd., Vancouver.

Save time . . . Save money . . . Save worry . . .
LET A WAGNER MOTOR AUTHORITY HELP YOU
Select the RIGHT MOTOR for the job

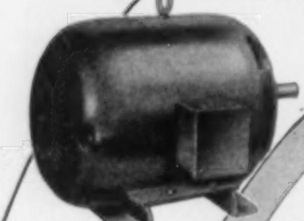


General-Purpose Squirrel-Cage Motors—low-slip, normal-torque motors suitable for a wide variety of applications.

Elevator Squirrel-Cage Motors—designed for elevators, cranes, hoists, and other applications involving very high starting-torque, and which must be started, stopped, and reversed frequently.

High-Torque Squirrel-Cage Motors—suitable for hard-to-start machinery such as crushers and compressors.

Punch-Press Squirrel-Cage Motors—a high-slip motor suitable for driving punch presses and other machines which have heavy flywheels or flywheel effect.



Totally-Enclosed Fan-cooled Motors—the ideal motors for locations where dust, filings, fumes, moisture, and other abrasive and corrosive agencies make the use of open-type motors undesirable. Approved for Class II Group G locations.

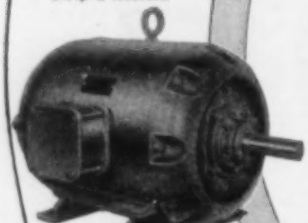
Wound-Rotor Motors—popularly known as "slip-ring" motors for applications involving variation in operating speeds and starting torques, or requiring very high starting-torque with low starting-current.

Wagner's
COMPLETE LINE MAKES POSSIBLE A WIDE SELECTION FROM STANDARD TYPES

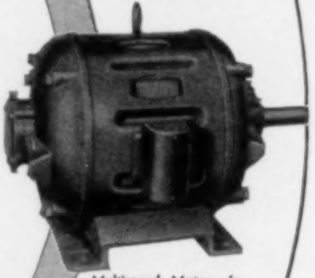
You'll save time, money, and worry if you consult a motor authority when you need electric motors.

To select the *right* type of motor for any given application, requires a comprehensive knowledge of motor ratings and characteristics, power transmission, control equipment, operating conditions, rules and regulations established by power companies, and even laws enacted by local governments. Our experts, motor specialists, make it their business to keep informed regarding all of these motor-application factors.

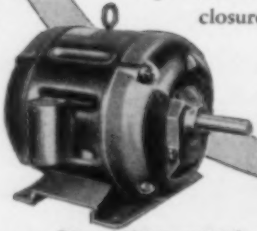
You'll save time and money if your motor needs can be filled by *standard* types. Wagner's ability to fit the RIGHT MOTOR to the job is due to a complete line which includes motors in sizes from 1/125 hp. to 400 hp., for all current specifications, with a wide variety of enclosure types and mountings.



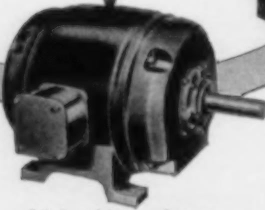
Explosion-Proof Motors—for Class I Group D locations involving flammable volatile liquids, highly-flammable gases, and other highly-flammable substances.



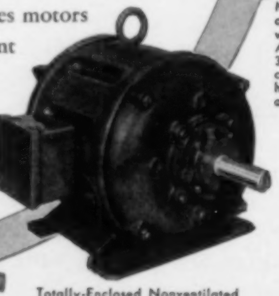
Multispeed Motors—for applications involving variation in motor speeds. Available as 2-speed, 3-speed, and 4-speed; constant-torque, constant-horsepower, and variable-torque motors.



Dripproof Motors—protected against dripping liquids and falling metal chips and other particles from entering the motors.



Splashproof Motors—for outdoor and indoor locations where motors are subjected to splashing liquids.



Totally-Enclosed Nonventilated Motors—the equivalent of the totally-enclosed fan-cooled types, but in smaller ratings not needing external fan cooling.

Write for

BULLETIN MU-182

which will give you a comprehensive story of the Wagner Line.

MOTORS

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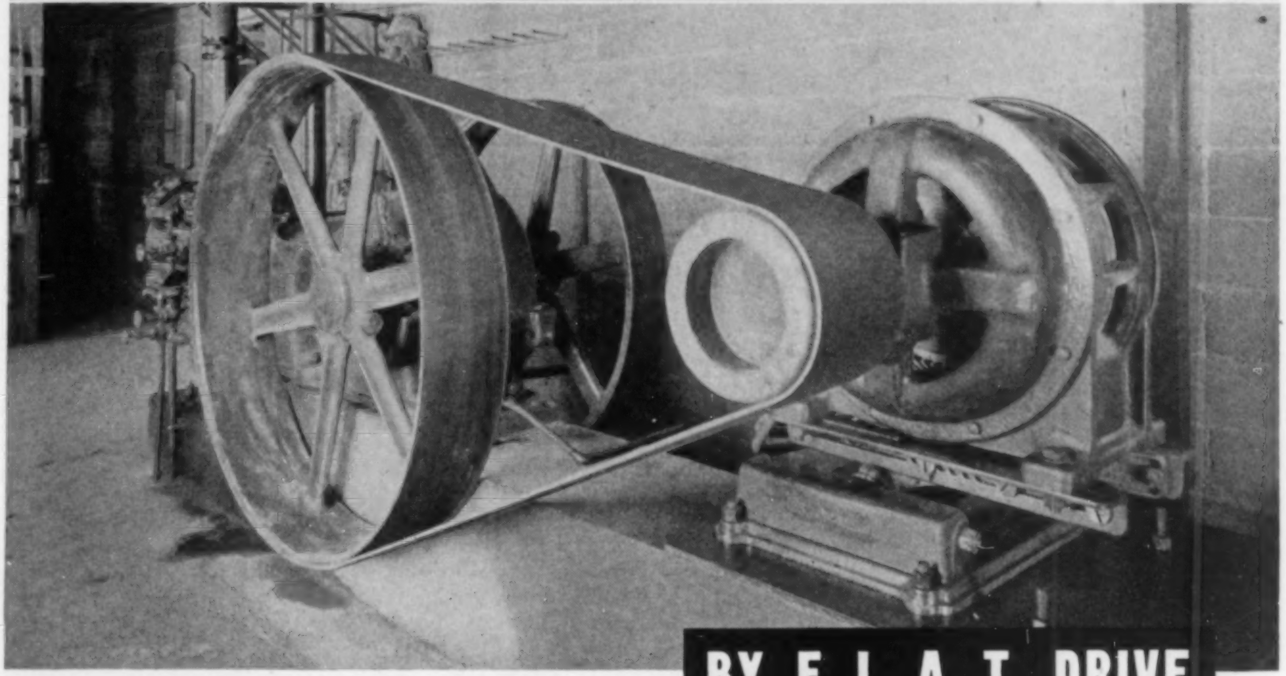

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ON THE COVER

SGT. Donald E. Hudson of deKalb, Ill., is shown at the controls of a motorboat that he built in Italy from miscellaneous materials. With him (right) is Pfc. Eric H. Staples of Sanford, Me. The passenger compartments are two jettison tanks used by P-38 Lightning fighter planes to carry extra gasoline. The engine powering the craft was taken from a small air compressor in a salvage yard. The propeller was made from scrap metal. Both soldiers are ordnance workers in the 464th Liberator Bomb Group of the U. S. Army 15th Air Force.

●

IN THIS ISSUE

ONE of our oldest materials, glass, has assumed new and useful forms in recent years and among them is Fiberglas, one of the most interesting. Most of the current output of these glass filaments is now being fabricated into products for war purposes, but they will serve both industries and households after hostilities are ended. Our leading article tells how Fiberglas is made and used.

●

ROCK drills are, of course, designed to drill holes in rock, but a government engineer in charge of a foundation-testing job successfully employed a wagon drill in soil. He wanted to know the depth to rock, and the conditions were such that he got the information quicker and at lower cost than would have been possible with the use of conventional equipment. See page 206 for details.

●

THE scope of usefulness of compressed air in marine salvage operations has been considerably broadened by the wartime work of the British Admiralty Salvage Department. A review of its operations begins on page 210.

●

WE HAVE heard much during the war of the manufacturing ingenuity of Higgins Industries, Inc., of New Orleans, La. One of its recent products is a lifeboat that is parachuted from the sky to succor airplane crews forced down at sea. Compressed gas serves to right it after the plunge. See article on *The Flying Dutchman Lifeboat*, page 214.

Compressed Air Magazine

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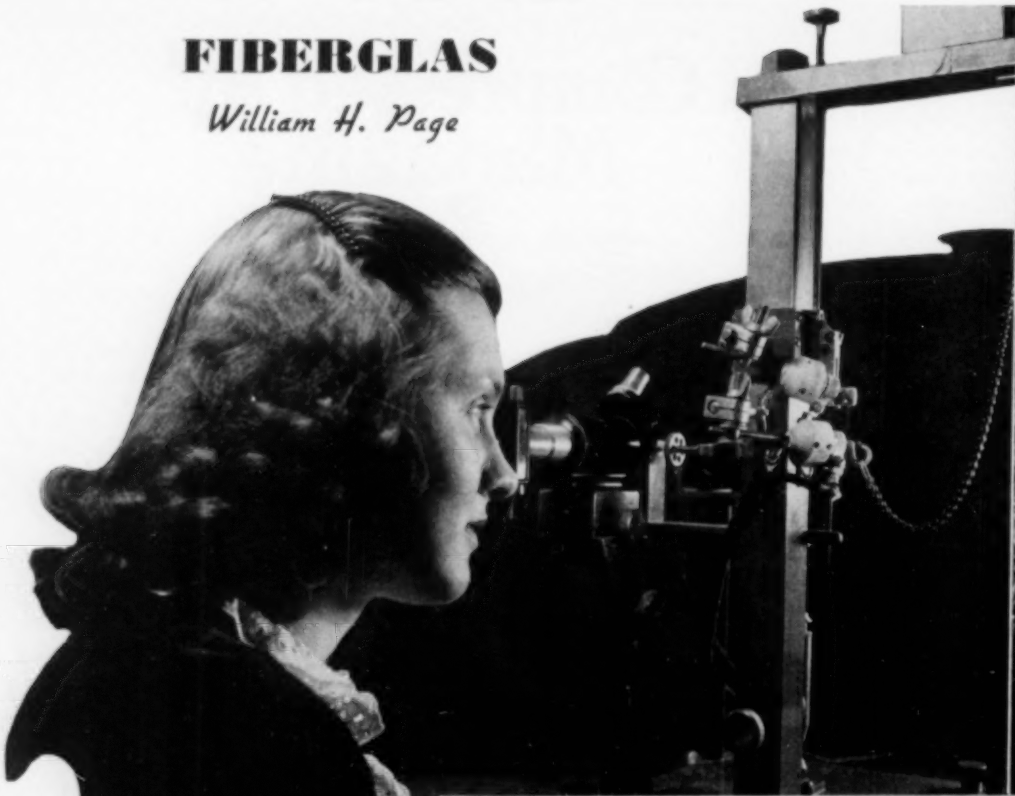
FIBERGLAS

William H. Page



TESTING GLASS FIBER

Single fibers of glass used for the reinforcement of plastics have tensile strengths ranging from 275,000 to 375,000 pounds per square inch.

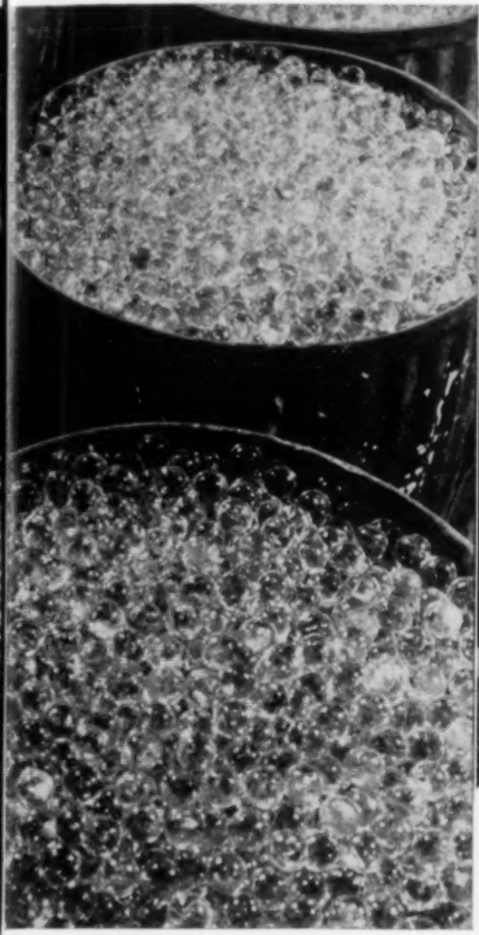
NO RECORD exists of the beginning of the art or industry of glass making. The start was made in remote antiquity, long before mankind knew how to keep written records. As many as 10,000 years ago, some nomadic tribesman may have found molten glass beneath the bed of a hot campfire built upon sand. If his curiosity led him to poke the glowing, viscous pool with a green-wood stick or some handy weapon, it is probable that he drew a glass fiber on the end of his implement.

Molten glass has much the same consistency as honey or molasses; it strings out tenuously. Thus it is quite possible that the first form in which this material was made through man's action was a glass filament. Between the shaping of this crude fiber and the production of useful fibers on a commercial scale there stretched an interval of thousands of years. By the time of the Renaissance, artisans in glass were attenuating fine rods for many ornamental purposes, including "spun-glass" decorations on stemware; but until a comparatively few years ago the art of glass making had developed much more rapidly along other lines.

In 1893, Edward Drummond Libbey exhibited a dress, lampshades, and other articles of glass at the Columbian Exposition. But the fabric was made of bundles of coarse-glass fibers woven together with silk threads. Crowds came to see Georgia Cayvan, reigning actress of the day, wear the famous gown; but it is suspected that most of the eager spectators came because they thought the dress was transparent. If they did, they went away disappointed. This was not the only disappointment. The material was too stiff to be creased or folded—it was not a true, all-glass textile. It was no more possible then than it had been before to weave a fabric of glass filaments alone. The result of Mr. Libbey's experiment was spectacular and attracted a great deal of attention, but it proved to be of no practical value.

In the early 1900's a number of patents were issued in Germany, and some in England, on various processes for drawing finer fibers of glass. While those produced by the methods were still too coarse for weaving practical cloths, they were used to some extent as a thermal insulating material, particularly in Germany during the period of the First World War when the Allied blockade shut out importations of asbestos.

The real start towards commercially



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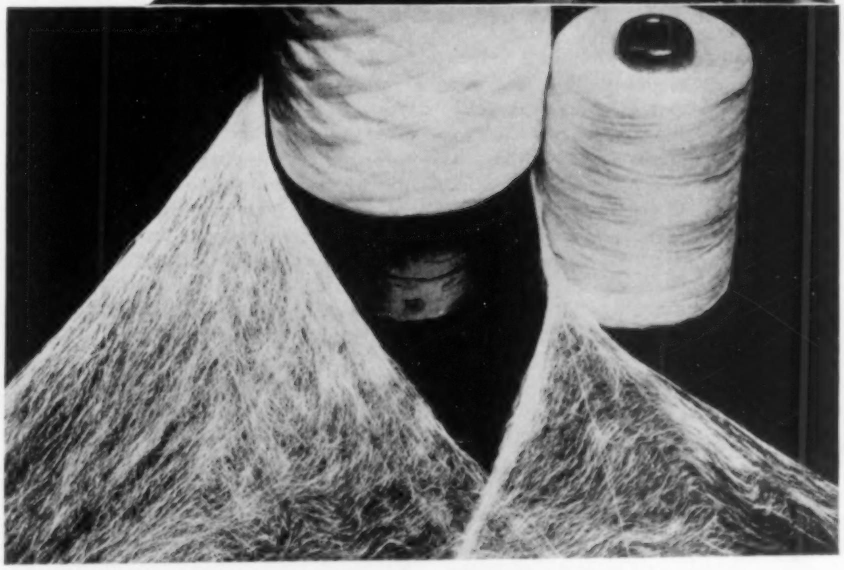


useful glass filaments was made in 1931 when research, aimed at the development of the necessary processes, was initiated in this country by the Owens-Illinois Glass Company, manufacturer of glass containers, and by the Corning Glass Works, makers of specialties ranging from light bulbs to laboratory glassware and giant telescope mirrors. From 1931 to 1938 the two concerns, working separately towards the same goal, spent millions of dollars in devising the methods and acquiring the knowledge needed to produce glass in fiber form on a commercial scale. Rapid progress was made in improving manufacturing processes and products and in developing markets.

During that period, relatively coarse glass filaments coated with an adhesive proved their value as air filters. Steady gains also were made in the field of thermal and sound insulation because of the availability of finer wool-like glass fibers. Still finer and stronger ones were produced subsequently, and by 1936 it was possible to manufacture filaments pliable enough to be woven into all-glass textiles that could be creased and folded. Late in 1938 the Owens-Corning Fiberglas Corporation was formed to continue the production of Fiberglas (glass fiber) materials, to carry on further research, to explore additional fields of application, and to adapt the fabrics

STEPS IN MAKING GLASS-TEXTILE FIBERS

The glass-making ingredients are melted and refined in small furnaces (opposite page) and the resultant product is formed by machine into glass marbles (top-center) that offer a convenient means of inspecting the glass and eliminating impurities. The marbles are remelted in small electric furnaces, and the molten glass is drawn into fibers in one of two ways. Staple fiber is made by flowing the glass through orifices in the base of each furnace and applying blasts of compressed air to yank the issuing streams into silky filaments resembling long staple cotton or mohair. Individual fibers are as little as two ten-thousandths of an inch in diameter and are formed upon a revolving drum into a gossamer web that is gathered and twisted into a strand by a subsequent winding operation (above). The strands are made into yarns by conventional textile machinery. Some of the webs are united with a binder and rolled (top-right) into a flexibie sheet from 10 to 50 one-thousandths of an inch thick for use as an insulating material.

OEM photo by Palmer

WOOL-LIKE BATS

This shows a bat of Fiberglas issuing from the forming chamber, where thin streams of molten glass are attenuated by the impact of steam. In this form, the product is widely used for thermal and accoustical insulation on board naval vessels.

for still other uses which their inherent properties made them uniquely qualified to serve. The new company acquired all the assets that Owens-Illinois and Corning had devoted to the development and manufacture of fibrous glass.

Fiberglas, as the foregoing makes plain, is not a "war baby"—it was well established in many homes and industries before the outbreak of hostilities. But since the war, substantially the entire output of the corporation's three plants at Newark, Ohio, Ashton, R. I., and Huntingdon, Pa., has gone to meet the requirements of the armed forces. In its wool-like form, one of the largest current uses of Fiberglas is as a heat- and sound-insulator on Navy fighting ships and auxiliary vessels, including landing craft; on Army troop transports and refrigerated barges; on tankers and on Liberty and Victory ships.

Early in the war it was recognized that fire incident to enemy shelling, bombing, and torpedoing was the greatest single hazard to both combat and merchant vessels and took an appalling toll of human lives. To reduce the danger it was necessary to eliminate all construction materials that were combustible or that would smolder and give off noxious fumes. Fiberglas heat- and sound-insulating bats, rolls, blankets, and boards were substituted, and Fiberglas fabrics were used as a wrapping to hold insulation on piping and for other similar purposes. Six months after the United States declared war on the Axis powers, 75 shipyards were utilizing various forms of the material to insulate shipboard living and refrigerated spaces, magazines, bulkheads, pipes, ventilating ducts, casings, and boiler uptakes.

In 1944 the company produced for the nation's fighting and merchant fleets many millions of square feet of insulation, including more than 60 million square feet of a type in the shape of a board that had been developed especially for the Navy and that offers one of the many examples of fruitful coöperation between industry and the armed forces to meet the demands of war. As far back as 1939 the Navy had adopted Fiberglas for thermal insulation throughout all its fighting ships. The customary practice then was to install bats or rolls of it behind aluminum sheathing. At that time there was no shortage of aluminum, but the Navy wanted a rigid form of insulation that could be used on both horizontal and vertical surfaces and that, by doing away with sheathing to hold the material in place, would save weight and installation time.

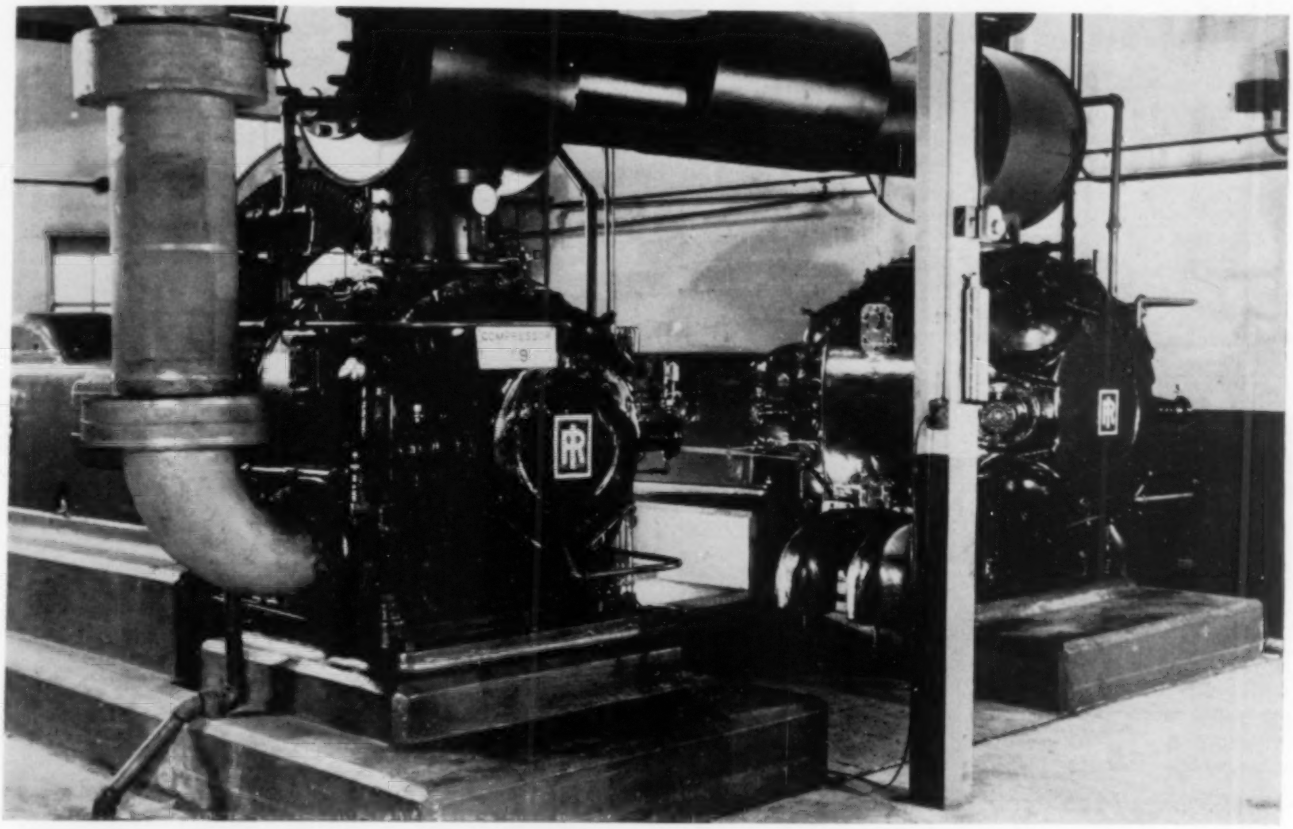
The problem was tackled by the Fiberglas Corporation. The company had been working on a board of the general type required, but the product was still in the experimental stage. In addition to finding a binder that would give the desired rigidity, it was necessary to provide an adhesive that would hold a fabric, serving as interior finish, to one surface of the board. Research was intensified; the coöperation of binder and adhesive manufacturers was secured; and test applications were made on a number of naval vessels. A production line for the manufacture of the board and for applying the facing of incombustible Fiberglas cloth or flameproofed rayon was worked out and set up in a new, hastily erected building. By Pearl Harbor day a satisfactory product was being made in ever-increasing volume.

As first installed, the board was secured with an adhesive to steel surfaces such as beams, stiffeners, bulkheads, decks, and shell plating, all of which call for both thermal insulation and good surface appearance. By a later method it is held in place by mechanical fasteners welded to the steel. When all joints are covered with Fiberglas stripping tape the whole construction is painted. When completed, it has not only the thermal- and sound-deadening properties required but also a neat interior finish.

In 1942 the Fiberglas Corporation turned out more than 22 million square feet of the new material for the Navy as well as for ships built for the Maritime Commission. During the first nine months of that year, at the time of a critical shortage of aluminum, use of the board by the Navy saved more than 5,500,000 pounds of aluminum that would otherwise have been needed for sheathing, or enough for the construction of 250 heavy bombers. Production in 1943 was approximately double that of the preceding year, and in 1944 it was nearly three times as great as in 1942.

It is estimated that there are approximately 80,000 square feet of this type of insulating board on a battleship, some 158,000 square feet on a heavy cruiser, about 38,000 square feet on a destroyer, and around 271,000 square feet on an aircraft carrier. The total footage of Fiberglas boards, blankets, rolls, or bats on a "flattop" will run to approximately 360,000 square feet. In addition, there will be about 326,000 linear feet of Fiberglas tapes and cloths for stripping and for wrapping insulated pipes.

In meeting war requirements for thermal- and sound-insulating materials, the corporation and applicators have made improvements in Fiberglas products as well as in their methods of installation that will be of decided value when the nation's war-built tonnage is converted to peacetime service. In many instances they will also prove to be suitable for insulating homes, factories, and other kinds of industrial and commercial buildings. A large combat or merchant vessel, with its complex propulsion machinery and refrigerating and heating systems, is fairly comparable to a good-sized industrial plant, although the ship is likely to encounter conditions that the factory will probably never experience.



AIR COMPRESSOR

A 700-hp. electrically driven air compressor which is one of twelve machines in Owens-Corning Fiberglas Corporation plants. In addition to its principal use of drawing streams of molten glass into fine fibers, compressed air serves to operate pneumatic tools, paint-spray guns, and other maintenance equipment.

Insulating materials and means of installation that will stand up under the shock of shell fire, constant vibration, and the other stresses, strains, and hazards of shipboard service are certain to find many peacetime fields of application.

A recently developed Fiberglas product is a flexible sheet, ½ inch thick, that is used in cabins and on flight decks of aircraft to insulate them against the extreme cold of the stratosphere and to deaden sound. Its weight is only 6/10 pound per cubic foot, or approximately one-fourth that of the material it replaces. When subjected to a mean temperature of 125°F. and to 90 percent relative humidity, the sheets increase less than 1 percent in weight, in contrast to as much as 40 percent in the case of the organic material formerly employed for this twin purpose.

In textile form—tapes, braids, cloths, sleevings—and impregnated with a suitable varnish, Fiberglas serves widely as an insulation for motors, generators, transformers, etc. Because it occupies little space and is resistant to high temperatures, it has proved a major aid to electrical design engineers in their efforts to reduce the size and weight of electric units required to do a given job. Within recent years, they have been able by means of this material to cut down the weight of a 10-hp. motor by as much as 170 pounds, while Fiberglas-insulated motors made for special war uses weigh only 1 pound per horsepower. One of the smallest but most vital of this type in a plane is the pitch-change motor which changes the pitch of propellers that have gone dead so that the blades are turned edgewise to the wind.

War needs have been largely responsible for two developments that forecast broader peacetime applications of Fiberglas textiles in the industrial field. In one case the fabrics are used to reinforce plastics; in the other the cloths are coated with synthetic rubbers or resins. In fabricating Fiberglas-reinforced plastics, layers of the textile are impregnated with a low-pressure, thermosetting resin and are placed one on top of another until a laminate of the wanted thickness is built up. The latter is then draped over a mold or put inside of one to give it the desired form, after which it goes into an oven for curing.

Fiberglas-plastic combinations possess extremely high strength in proportion to their weight. Test specimens have shown tensile strengths of from 50,000 to 80,000 pounds per square inch, compression strengths of more than 50,000 pounds per square inch, and impact strengths exceeding 30 foot-pounds, as compared with 2 foot-pounds for ordinary plastics. Their most spectacular application so far has been that of making aircraft parts, including cabin structures of helicopters constructed for the armed forces; but designers and engineers are already experimenting with the material for many postwar civilian uses such as the manufacture of strong, lightweight luggage, boats and canoes, furniture, kitchen and bathroom assemblies, refrigerator and radio cabinets, and dozens of other products where lightness, combined with high strength and ease of fabrication, is the goal.

The requirements of the Army have led directly to the development of Fiberglas fabrics coated with synthetic rubbers or resins. These textiles have exceptional tear strength, withstand repeated flexing, are resistant to destruction by fungi, and have great dimensional stability. Other properties vary with the coating employed, but rubber-covered Fiberglas cloths are being produced that are flameproof and have high resistance to moisture penetration and to the effects of contact with gasoline, oil, chemicals, and greases. It is because of these qualities that coated glass fabrics are at present being used to make airplane battery covers, hangar-door curtains and side walls, oil-pressure-switch diaphragms, aircraft tape for expansion joints of hot air ducts, water tanks for troops in the field, and protective clothing for workers in chemical plants. Possible future products include tarpaulins and other moisture-proof covers for machinery, water-resistant containers for delicate instruments, carburetor diaphragms, and an awning that will not burn when a lighted cigarette is tossed on it from an upper-story window.

One of the first practical applications of Fiberglas, as has already been mentioned, was the air filter. It consists of mats of relatively coarse fibers treated with an adhesive and is widely employed today in war plants to collect abrasive dusts created by manufacturing processes, thus eliminating a hazard both to the products being made and to the health of workers. Coarse fibers held together by a binder also are used by the petroleum, chemical, and distilling industries as a packing for distillation columns, acid coalescers, and scrubbing towers. The great surface area of the material and large free volume increase operating efficiency and speed output. With tower packing of this type engineers are able to build rectifying columns that will convert high wines to 191.5-proof industrial alcohol in approximately half the time formerly required.

Retainer mats for storage batteries likewise represent an early application of Fiberglas that has become standard over the years. Fine glass fibers treated with a binder are formed into thin, waferlike, porous mats that indefinitely withstand immersion in battery acid. Positioned one on each side of every positive plate, they hold in place the power-producing material that tends to shed off under hard usage, shock, or heavy vibration and thus give longer life and greater stamina to storage batteries in trucks, tanks, and jeeps, and those on which submarines operate.

A very recent development is the Fiberglas mat that is used to protect underground oil, gas, and other pipe lines against corrosion and electrolytic action. It is in the form of a broad tape that is wrapped around the piping and serves as a carrier for the bitumen or coal-tar coating. The large surface area presented by the fibers permits the application of more coating for a given thickness of wrapping, as compared with other carriers.

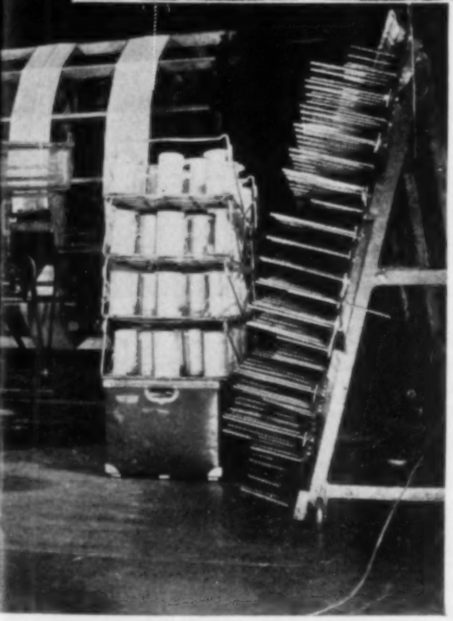
In the production of the wool-like Fiberglas for thermal and acoustical insulation, the sand, limestone, and other minerals of which it is composed are unloaded from freight cars into large elevated storage bins, each equipped with a weighing hopper connected to an automatic recording scale. Batches are prepared by collecting the precise quantity of each ingredient in a traveling car and then mixing them in a rotary mixer. From the latter the batch is discharged into cans that are transported by a monorail system to glass tanks or furnaces, which have a capacity of 40 tons or more. After melting and refining, the glass reaches the forehearth where there are perforated bushings through which it flows in thin streams. As it emerges from the orifices it is exposed to the impact of high-pressure steam jets that attenuate it into long, resilient fibers.

At the base of the forming chamber the material is gathered on a traveling conveyor as a white, fleecy mass of fine filaments intricately interlaced with one another. Diameter and length of the individual fibers are subject to control by regulating the temperature and viscosity of the glass, the orifice size, and the steam pressure, while the depth of the mass is controlled by the speed of the conveyor. In this form the product may be used for thermal and sound insulation; may be fabricated into sewn or metal-mesh blankets; or it may be treated with a thermosetting resin binder, compressed to the desired density and thickness, and passed through

OEM photos by Palmer

PREPARING YARN FOR FABRICS

Fiberglas textiles are now being used solely for war purposes, but they are suitable for a wide variety of peacetime applications. Colored-glass fabrics may serve as draperies in postwar houses, especially along sea coasts where salt air and intense sunlight play havoc with most of the materials now used. Fiberglas textiles are resistant to flame, humidity, gasoline, oil, grease, and many chemicals and have far greater strength than most conventional fabrics. At the left, glass fibers are being twisted into yarn; in the right-hand picture are tubes of yarn ready to be woven; and the other view shows warp yarns being paralleled on a beam preparatory to weaving.



an oven to set the binder. The resultant material may range from a flexible sheet to a semirigid or rigid board.

An adaptation of the method just described serves to make coarse fibers for air filters and for aeration packs which are utilized for a variety of filtration purposes. They are, for instance, installed in air-conditioning systems where water is used for air cooling, humidity control, or air washing—the packs gathering any free particles of water that may be entrained in the air stream.

Two processes are employed in the production of glass-textile fibers. Both begin with accurate batch formulation and melting and refining, the latter taking place in "day tanks" or small furnaces. From these the molten material is transferred to a machine which turns out small marbles about ⅝ inch in diameter. These are formed to permit visual inspection of the glass for the purpose of eliminating impurities such as "stones" or bits of refractory material that would interfere with subsequent operations or impair the fibers. The marbles, which are known as "cullet," are then remelted in small electric furnaces. From this point on the two methods differ.

The staple-fiber process, which produces a fiber somewhat like long-staple cotton or mohair, resorts to jets of compressed air to attenuate the molten glass. The glass flows through orifices in special temperature-resistant bushings at the base of each furnace. Upon issuing from the latter, the force of the air yanks the thin streams into fine filaments and drives them down upon a revolving drum on which they form a thin veil resembling a cobweb. In their almost instantaneous descent to the drum the fibers pass through a spray of lubricant and a drying flame. The gossamer web is gathered from the drum into a strand that is lightly drafted in the ensuing winding operation so that the majority of the fibers lie lengthwise of the strand. These staple-fiber strands can be further drafted, if desired, and then twisted and plied into yarns of various sizes with textile machinery and processing methods similar to those used for cotton and worsted.

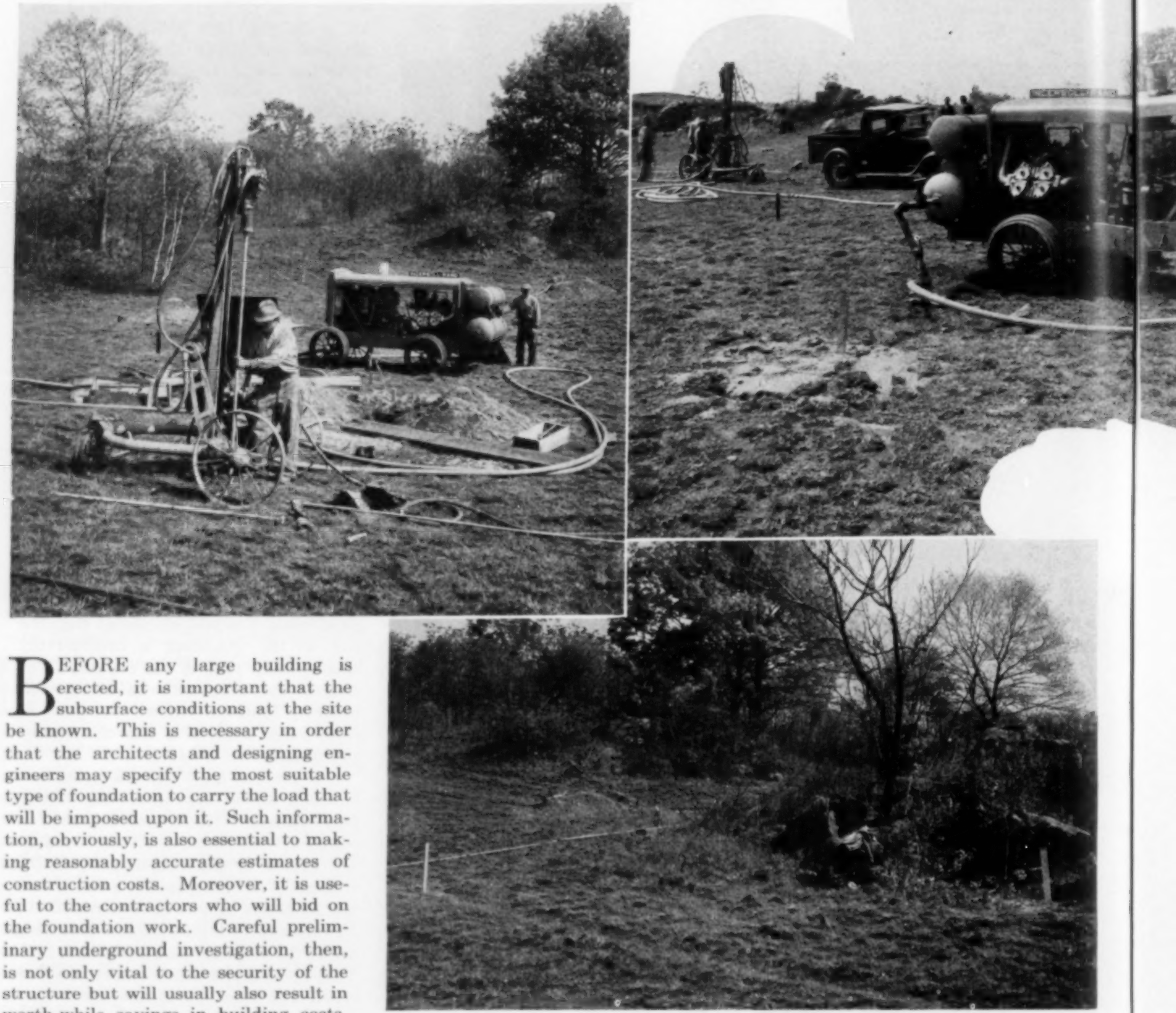
By the continuous-filament process, fibers of indefinite length, measurable in miles, are drawn mechanically. In this case the molten glass flows down through bushings provided with 102 or 204 small orifices. The resultant strand of multiple filaments is carried to a high-speed winding mechanism, on the floor below, and this draws the fibers at the rate of more than a mile a minute. The tension attenuates the glass while it is still molten so that the size of the filaments is considerably smaller than that of the orifices. The strands are "thrown"—to use a silk-industry term—or twisted and plied to form yarns that have the characteristics of silk.

The method by which Fiberglas mat is made differs little from the staple-fiber process. Here, too, the glass is converted into marbles; the marbles are melted in small furnaces; and the streams of molten glass are yanked into fine filaments by jets of compressed air. But instead of falling upon a revolving drum, the fibers drop on a conveyor belt. They are sprayed with a binder and then rolled into thin, flat sheets which may range in thickness from 10 to 50 one-thousandths of an inch.

Fiberglas has proved itself to be one of our most serviceable materials. Its war uses are the logical outcome of well-established peacetime applications, but neither, nor both, by any means exhaust its possibilities. Experimental work aimed at the development of additional industrial and household products have been shelved because of the pressure of war demands upon the Fiberglas Corporation's research facilities. When the total defeat of Japan lifts this pressure, then its engineers will again be able to turn their attention to new postwar uses for this adaptable form of an ancient material.

Foundation Testing with a Wagon Drill

C. H. Vivian



HOW ROCK DEPTH VARIES

An outcrop of solid rock is visible immediately behind the stake at the right. However, only 15 feet away, at the spot marked by the stake at the left, drill steel penetrated more than 18 feet before it struck rock.

BEFORE any large building is erected, it is important that the subsurface conditions at the site be known. This is necessary in order that the architects and designing engineers may specify the most suitable type of foundation to carry the load that will be imposed upon it. Such information, obviously, is also essential to making reasonably accurate estimates of construction costs. Moreover, it is useful to the contractors who will bid on the foundation work. Careful preliminary underground investigation, then, is not only vital to the security of the structure but will usually also result in worth-while savings in building costs. For these reasons, foundation or soil exploration work has received increasing attention as building science has progressed and now constitutes a well-developed branch of the construction industry.

The equipment and procedures used for the purpose have become fairly well established, but now and then a job is encountered where conventional practices do not seem to work out to the best advantage, and then something different is tried. Such a case arose recently near Peekskill, N. Y., where the Veterans Administration is preparing to build a $6,000,000 hospital for the care and treatment of wounded and disabled service men. In this instance it was discovered that the essential information on subsurface conditions could be obtained quicker and at lower cost by putting down holes with standard rock-drill equipment than by any other means.

The hospital site is on high ground on the east bank of the Hudson River near Crugers, a village about 5 miles south of Peekskill. In this scenic and peaceful setting, the Government has acquired a 383-acre tract, most of which was formerly owned by the Westchester County Parks Commission. Save for a few scattered farms, it is now unoccupied. The size of the property, together with the fact that the area for miles around is relatively sparsely settled, insures the quiet and isolation desirable for the rehabilitation of war casualties.

The region is one of rolling topogra-

DRILLING CREW AT WORK

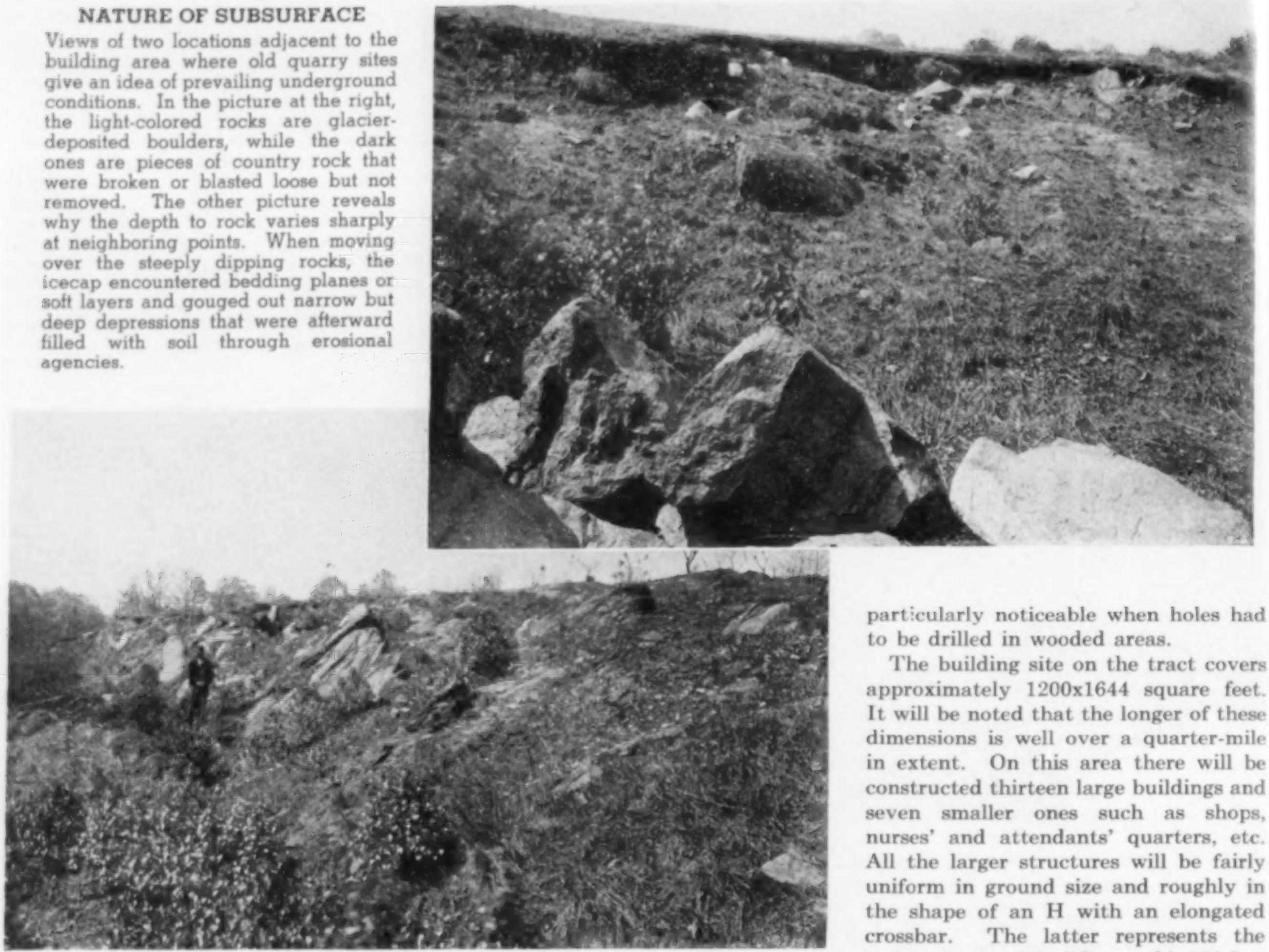
A general view and two close-ups of the operations that show the character of the terrain and indicate how well the portable compressor and wagon drill were adapted for the exploratory work. The use of a long air-delivery line made it possible to drill all the test holes for one building without moving the compressor. In the picture at the extreme left there is a hand-dug test pit between the drill and the compressor.

phy, and there are plentiful outcroppings of rock ranging from a predominating fine-grained, dark-colored gneiss to a coarser schist containing varying amounts of mica. Some of the rock has been rendered very heavy through an admixture of iron ore, and close to the building site is a shallow quarry from which emery for use as an abrasive was taken during World War I. The outcrops may be loosely compared to islands rising in a sea of soil, but there is no regularity in this geological pattern. In general, the projecting rocks form the high points in the terrain, but this is not always true. Some of the local apexes consist of areas that are level on top, or of gently sloping land covered with soil thick enough to bear cultivation. Also in some of the lower-lying sections where soil ordinarily makes up the surface there are outcroppings of rock.

The explanation for the nature of the terrain is found in the fact that eons ago a glacier moved down across the region from the North. We may assume that the surface had been made irregular by erosion even before that time and that the advancing icecap then massaged the wrinkled face of Mother Earth. In some places it leveled off high points; in others it scoured depressions which varied considerably in width and depth. As the ice melted, it deposited the silt and drift and boulders it was carrying, and these naturally came to rest in the valleys between the rocky areas. This glacial debris subsequently became cemented together to form a hardpan directly overlying the rock base and ranging up to 5 feet in thickness. Since those days, weathering agencies have added their alterations to create the present topographical conditions. In some spots that appear to be soil, superficial digging has proved the surface to be decomposed rock that rapidly becomes more consolidated with depth. At such points, solid rock in place is only a few inches down.

This sketchy outline of the geological conditions gives an idea of the difficulties that confronted the soil-exploration crew whose job it was to make subsurface investigations and recommend the type of foundations that would meet requirements. The man detailed to head the work was O. B. Lane, a structural engineer of the Veterans Administration with eighteen years of experience in work of a similar nature. It was evident that the rock in place would form a firm footing for the buildings, and it was desirable to rest the foundations on this rock base insofar as possible. The job consequently resolved itself into one of determining the thickness of the overlying soil and hardpan. A start was made by using ordinary methods, but they proved to be either too slow or to give inconclusive results. The digging of small pits with hand tools was first tried, but in some places the ground was so hard that a man could excavate a hole only 2 feet deep in half a day. Boring with hand augers was next attempted and rejected as unsatisfactory because, when an obstruction was met, there was no way of telling whether it was a glacial boulder or rock in place.

Mr. Lane then concluded that some form of power drilling would have to be employed. Machines generally used for test-boring purposes embody some means of driving casing into the ground, usually by the so-called wash-boring method. Specimens of the soil are taken by a sampling tube of one kind or another fitted with valves and various devices to prevent losing the specimen as the tube is withdrawn. Samples thus obtained are examined or submitted to a laboratory to determine their load-bearing strength and other characteristics. There are contractors that specialize in this type of boring, and one of these



NATURE OF SUBSURFACE

Views of two locations adjacent to the building area where old quarry sites give an idea of prevailing underground conditions. In the picture at the right, the light-colored rocks are glacier-deposited boulders, while the dark ones are pieces of country rock that were broken or blasted loose but not removed. The other picture reveals why the depth to rock varies sharply at neighboring points. When moving over the steeply dipping rocks, the icecap encountered bedding planes or soft layers and gouged out narrow but deep depressions that were afterward filled with soil through erosional agencies.

was asked to visit the site and to make an estimate on the cost of the work with his equipment. After looking over the situation and learning the character of the ground, he offered the discouraging information that, while such operations usually ran from $3 to $6 per foot of hole drilled, he would not venture to bid in this particular case.

Since the primary purpose of the boring was not to take soil samples but merely to probe the ground to learn the depth to solid rock at various points, thoughts naturally turned to equipment designed for ordinary drilling. The most effective of such tools is the air-operated rock drill, so it was decided to bring one in and try it out. Arrangements were made with a roadbuilding contractor for the rental of an Ingersoll-Rand wagon drill, an I-R 315-cfm. portable compressor, and an experienced crew of three men.

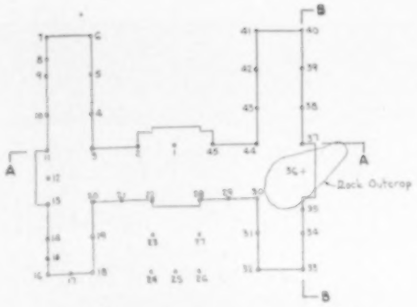
It might be reasoned that if a rock drill will penetrate solid rock at the rate of several inches per minute it ought to have little difficulty in putting down a hole in earth. However, such an argument does not always hold good. The walls of a hole in rock are solid and will not cave and bind the drill steel. Furthermore, the cuttings in rock are hard fragments that can be readily removed from the hole by sending down a stream of air or water, or both, through the hollow steel. In some kinds of earth, notably clay or gumbo, trouble is experienced in preventing the hole in the steel from clogging. A plugged steel halts the removal of cuttings, and binding is likely to result soon.

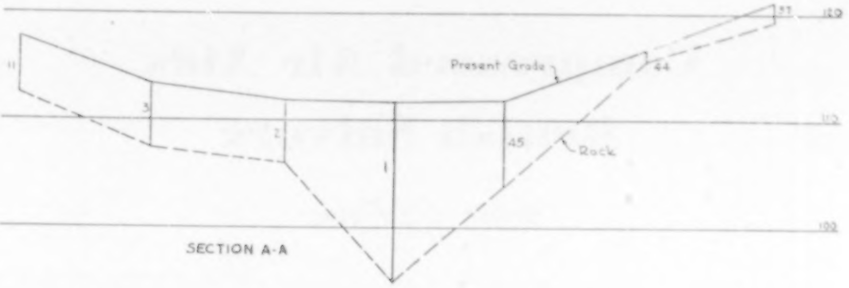
As it happened, conditions were favorable to rock drills. The ground is of a generally sandy nature with sufficient clay to give it cohesion but not enough to make it sticky when wet. That meant that the walls of a hole would not cave in and bind the steel. Except in low places, holes were put down without encountering ground water; but in the hollows it was present even close to the surface. In such locations a hole could not be maintained without casing, and rock was reached by the use of extensible drill steel. As a section was driven to its limit, another piece was added by threading it on above ground, and this procedure was continued until the hole was down to rock. Being readily portable, the drill and compressor could be moved about on the irregular surface with far less difficulty than would have been the case with heavier and more unwieldy equipment of other types. This advantage was particularly noticeable when holes had to be drilled in wooded areas.

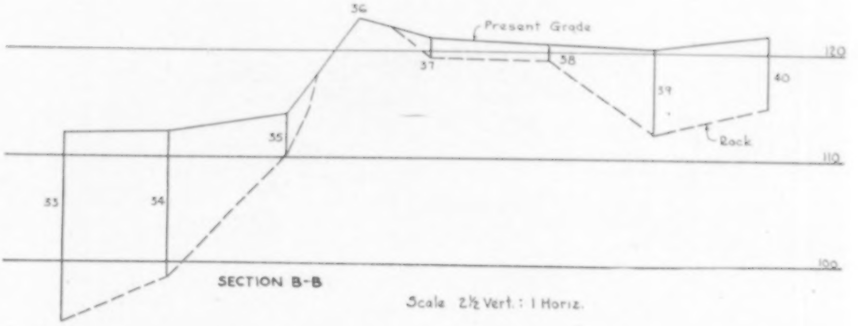
The building site on the tract covers approximately 1200x1644 square feet. It will be noted that the longer of these dimensions is well over a quarter-mile in extent. On this area there will be constructed thirteen large buildings and seven smaller ones such as shops, nurses' and attendants' quarters, etc. All the larger structures will be fairly uniform in ground size and roughly in the shape of an H with an elongated crossbar. The latter represents the main axis of each building and is 200 feet long. Wings at either end will be 150 feet long. The structures will vary from two to five stories in height and there will be full basements under all of them.

In order to obtain adequate data about underground conditions, the general scheme was to drill holes along the building lines and throughout the area to be covered by each one, the maximum spacing between holes to be 50 feet. Actually, this interval was reduced in some cases because adjacent holes sometimes differed greatly in depth to rock. In such instances, one or more intermediate holes were put down to get a more accurate idea of the rock contour. The equipment selected made it economically feasible to do this. In fact, it provided a moderate amount of information at a great many points, whereas with conventional soil-testing apparatus it would have been possible in the same time and with the same monetary outlay to get more detailed information at far fewer places.

From 36 to 40 holes were usually drilled in each large building area. Their depth varied widely, ranging from 0 feet where rock existed at the surface to 25 feet. At the start of operations, the steel on hand permitted drilling holes only 18 feet deep, but there were few of them that did not enter rock before that depth







PLOTTING ROCK CONTOUR

The drawing above shows the ground plan of a typical building, measuring approximately 200x150 feet, with drill-hole locations spotted on it. The two other sketches are profiles of the rock surface at two sections as plotted from test-hole data.

was reached. Those that were still in earth at 18 feet were left for the time being and later carried down to rock after some coupled steel had been obtained to make deeper drilling possible.

Drilling revealed some surprising facts regarding the contour of the rock floor. At some locations there are what amount virtually to crevices, as indicated by a deep hole between two shallow ones. Where such conditions were encountered, enough intermediate holes were put down to determine the rock slopes with a measure of accuracy. The working speed was affected somewhat by the topography, the expanse of wooded area, and other factors, but it was generally feasible to cover the entire site of a large structure in a day, and in one instance the drilling was done between nine in the morning and three in the afternoon, with time out for lunch.

The drilling element of the FM-2 wagon drill used for this work is of the heavy-duty drifter type. The rate of feed is controlled by an air motor, which provides a range of pressure from 0 to 1000 pounds. The entire unit is mounted on three steel wheels. On fairly level ground it was shifted to new hole locations by the crew. A small pick-up truck served to tow it when hand moving was impossible. Where steep slopes had to be negotiated, or where the machine had to be transported through wooded areas that would have required extensive operations to clear a roadway for a truck, it was moved by means of block and tackle. The block was attached either to a tree or to a piece of drill steel placed in a hole put down in a rock outcrop with a Jackhamer. The heavier portable compressor, also mounted on steel wheels, was hauled by a larger truck. It did not have to be moved frequently, however, because 600 feet of pipe line and hose was provided for the delivery of the air. This made it possible always to station the compressor on favorable terrain.

Drilling was done with standard 4-point Jackbits on 1¼-inch hollow, round steel. Bits were of 2⅝-inch gauge, and it was not necessary to change them often because most of the drilling was in material that did not dull them or reduce their gauge rapidly. Six-foot changes of steel were used. Before inserting a longer steel, the hole was blown clear of cuttings and dirt that had fallen into it. This was done by a conventional blowing tube attached to the end of an air hose. The hole was similarly cleaned out whenever the behavior of the drill steel indicated need of it. The air motor that controlled feeding and withdrawal of the drill had sufficient power to pull the steel out of the hole without difficulty on most occasions when it showed a tendency to bind, and little time was lost in having to work stuck steels loose.

While this method of exploration was not considered to be a positive means of locating rock in place, it gave sufficiently definite results for the purpose. If the bit was on a glacial boulder, the overlying ground was disturbed to such an extent as to cause noticeable vibration of the surface throughout a radius of several feet around the hole. Besides, the sound of the drill was different than when it was in rock, for in the latter case there was a distinct ring that was well-nigh unmistakable to the members of the drilling crew who were accustomed to rock work. Whenever there was doubt in their minds, the hole was continued until they were fairly certain that it was in solid rock. Under such circumstances, further checking was done by drilling alongside test pits and excavations where the material could be observed and the cuttings and vibrations checked. But it is believed that in the great majority of cases solid rock exists where it was indicated by drilling.

The operations were carried on with four part-time laborers and a drilling crew of three. The laborers laid out the holes, did the clearance work in wooded areas, assisted in moving the drilling equipment when necessary, and did miscellaneous tasks. The entire job involved the drilling of 703 holes with an aggregate depth of 3567 feet and was completed in 25 working days.

BLOWING A HOLE

Between steel changes and also after completion, each hole was cleaned out with compressed air delivered to the bottom through a conventional blowing tube. Flying dirt is visible near the top of the drill.

Compressed Air Aids British Salvors

Allen S. Park

British Information Service photos

SCENES AT TRIPOLI

Views of the harbor of the North African port as it appeared after it was occupied by the British Eighth Army in January 1943. They show some of the damage wrought by bombing attacks. The retreating Germans blocked the harbor by sinking eleven ships and miscellaneous floating equipment across its entrance, but salvage crews opened a passage for 15,000-ton vessels in fifteen days.

COMPRESSED air, which has always been an indispensable agency in modern ship-salvage work, assumed added importance in the operations of the Naval Salvage Service of the British Navy during the European phase of the current war. A report of those activities by Capt. J. B. Polland, deputy director and chief technical officer of the British Admiralty Salvage Department, shows that they were on a scale far greater than ever attained before. As a result of the organization and equipment built up since 1939, Great Britain now has the finest and largest fleet of salvage craft ever assembled, including a great amount of special apparatus and what constitutes a surplus of experienced personnel. However, it is estimated that wartime sinkings of vessels have created at least ten years of salvage work, and it is likely that all the facilities will continue to be fully engaged for some time to come, but with their ownership and direction transferred from the government to private interests.

The scope of the wartime operations may be judged from the fact that they accounted for the salving of more than 5,000,000 tons of merchant shipping between September, 1939, and December, 1944. This exceeded by 250,000 tons the total of new merchant vessels built in the United Kingdom during the same period. The restoration to service of this vast fleet was of vital importance in view of the heavy loss in British mercantile ships that, up to the end of 1943, amounted to 11,500,000 tons out of a prewar total of 17,500,000 tons. The British Isles import so much of what they consume that a large merchant fleet is essential to their existence. The Germans, keenly aware of this situation, unloosed submarine and aerial attacks that were calculated to render the islands incapable of obtaining the food and supplies necessary to carry on war. In that crisis Britain was forced to take immediate steps to develop an efficient salvage service.

The nucleus around which to build was small, because the once important business of marine salvage had been steadily declining prior to the outbreak of World War II. Navigational aids such as the radio, gyro compass, and echo sounder had cut down the number of casualties at sea to the point where little salving had to be done, and, as a consequence, there were few British concerns engaged in this type of work. It is understandable, therefore, that some months were required to organize and equip an efficient wartime salvage service, and until that was accomplished,

the strength of the British merchant fleet declined at an alarming rate. Although all the existing facilities and resources of private salvage organizations were drawn upon, conditions dictated that the operations be conducted as a part of the navy, so plans were made accordingly.

We ordinarily think of salvage as the raising of sunken ships, but in wartime its primary purpose is to render first aid to crippled vessels so that they may reach port for repairs. To do this effectively, it was necessary to provide salvage services at locations convenient to all the extensive sea routes traveled by Britain's merchantmen. This resulted in stationing ships and establishing bases all around the coasts of the British Isles, as well as in Iceland, the Faroes, North Ireland, the Mediterranean, Africa, and India. Each vessel or base was manned by divers, riggers, shipwrights, and mechanics and equipped with a salvage plant and all sorts of engineering stores to make it capable of dealing promptly and effectually with any type of job that might arise. Although much useful work was done during the early stages of the war with ships, equipment, and men then available, plans were put underway as quickly as possible to provide facilities especially designed for the purpose and to train men in their use.

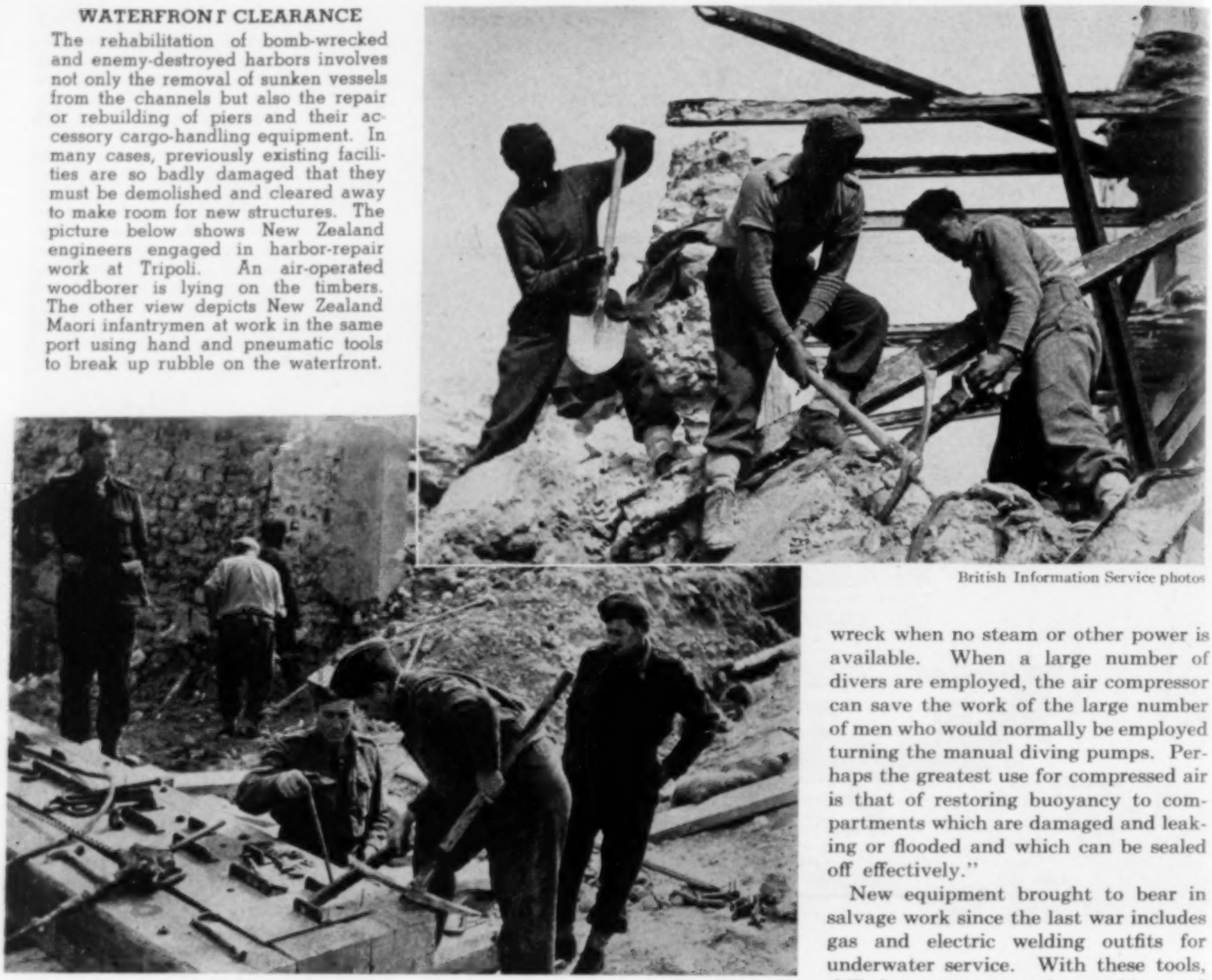
In addition to giving aid to stricken vessels at sea, the salvage service was required to conduct harbor-clearance operations on a very large scale. By means of mines, aerial bombs, and torpedoes, the Germans sought to and often succeeded in sinking ships in harbors, rivers, or narrow fairways where they would prevent or hinder the passage of other Allied vessels. It became necessary to remove these obstructions promptly, but the object was merely to get the ships out of the way and not to attempt to restore them to service. An enormous amount of this same kind of work was done later on in the war when the enemy, before evacuating ports, literally filled entrance passageways with sunken vessels and all sorts of material in an effort to keep Allied craft from entering them.

Four general types of salvage ships were developed, each designed to cope with a given set of conditions. Salvage jobs vary widely in accordance with the nature of the casualties and the characteristics of tides and shore lines. Vessels stranded on the north and west coasts of the British Isles usually suffer bottom damage from rocks, whereas they come to rest on sand on the east and south coasts. Tides assist in floating them around the British Isles, but in the tideless Mediterranean it is necessary to use equipment for the purpose. If a crippled ship is near a port of repair, a timber patch applied to its damaged plating will suffice to bring it in; but if a long ocean voyage has to be made, the temporary repairs must be more substantial.

The "Foremost" and "Dispenser" classes of salvage craft each has a displacement of around 900 tons. The "King Salvor" and "Lincoln Salvor" classes include vessels of around 1700 tons displacement. The former are driven with steam, while the latter, which are wooden ships designed and built in America, have diesel-electric propulsion. The crews range from twenty men for the smaller craft to 50 for the larger ones. The equipment is generally the same for all types, save that it is more extensive and varied on the bigger vessels. In all cases it includes lifting machinery, motor boats for diving operations, pumps, and air compressors. The "King

WATERFRONT CLEARANCE

The rehabilitation of bomb-wrecked and enemy-destroyed harbors involves not only the removal of sunken vessels from the channels but also the repair or rebuilding of piers and their accessory cargo-handling equipment. In many cases, previously existing facilities are so badly damaged that they must be demolished and cleared away to make room for new structures. The picture below shows New Zealand engineers engaged in harbor-repair work at Tripoli. An air-operated woodborer is lying on the timbers. The other view depicts New Zealand Maori infantrymen at work in the same port using hand and pneumatic tools to break up rubble on the waterfront.



British Information Service photos

Salvor" class carries three compressors: a stationary steam-driven machine with a capacity of 300 cfm. and two gasoline-engine portable units with a combined capacity of 475 cfm.

In addition to the salvage ships proper, there are numerous steel barges of special construction that are designed to raise wrecks that cannot otherwise be floated. They work in pairs, with the damaged vessel slung between them, special 9-inch wire ropes being passed under the hull at suitable intervals and made fast to the barges. The freeboard of the latter is then lowered by filling their ballast tanks. These are next pumped out and the lines beneath the wreck drawn taut. This gives the barges buoyancy which, plus the effect of the rising tide, serves to float the wreck, which is then towed until it grounds in shallower water. Some of these barges are 180 feet long and can lift 1200 tons, while others have a 600-ton lift. As there is room aboard for a large number of men, they are often used as floating barracks and workshops alongside wrecks that are being rehabilitated in harbors.

Centrifugal pumps are the principal portable equipment aboard the salvage ships. They are built for high suction lift and low pumping head, as these are the conditions most frequently encountered. Because they have to be moved through narrow openings, often by manpower alone, it is essential that their size and weight be kept down. Owing to the decline of the salvage business before the war, there were few manufacturers of such pumps when hostilities began, and the Admiralty was required to design its own.

"The next most useful piece of equipment carried by all salvage ships," states Captain Polland, "is the portable air compressor, which is usually a two-stage type driven by an internal combustion engine. It provides compressed air at 100 pounds pressure for working pneumatic tools, both above and below water, and also for driving a type of submersible sump pump which is an innovation in salvage work and one of the handiest and most reliable pumps for draining yet produced. Compressed air is also used for driving not only portable air winches but also steam winches on a wreck when no steam or other power is available. When a large number of divers are employed, the air compressor can save the work of the large number of men who would normally be employed turning the manual diving pumps. Perhaps the greatest use for compressed air is that of restoring buoyancy to compartments which are damaged and leaking or flooded and which can be sealed off effectively."

New equipment brought to bear in salvage work since the last war includes gas and electric welding outfits for underwater service. With these tools, skilled operators can do patching and repair work much faster than was possible a few years ago, and it is much more effective. The Temple Cox submerged bolt-driving gun is another new appliance that is much used. This is actually a gun, as it is fired with an explosive charge. With it, a diver can drive screwed studs or bolts into the hull plating of a vessel to secure a patch of steel or wood. It has been adapted for shooting a hollow bolt through the side wall or top of any compartment into which it is desired to introduce compressed air to assist flotation. The gun also punches as well as drills holes.

The salvage operations thus far discussed refer to merchant craft. Aboard the British Navy's fighting ships are crews trained to do their own first-aid work in the event their vessels sustain injury at sea, being organized into what are called Damage Control Units. Their object is to keep the fighting efficiency of their ship at its highest level and, in case of injury below the water line, to keep her afloat until she can make a port with repair facilities. As quick attention is of the utmost importance, there is obviously a better chance of saving a vessel with men aboard her ready to patch her up immediately than to be compelled to wait until shore-based crews can reach her.

Another effective means of keeping damaged ships afloat was a compressed-air system that was installed on oil tankers and that has been described by Captain Polland as follows: "Early in 1940, the Salvage Department of the Admiralty, having successfully used compressed air on the salvage of a number of tankers which were in danger of sinking through damage caused by bombs, mines, and grounding, drew attention to the ease with which the compressed air available on all motor tankers could be adapted and used by the crew to restore buoyancy and counteract flooding immediately tankers were torpedoed or mined at sea. The idea was developed by the Eagle Oil Shipping Company, which proceeded to fit all its motor tankers with a compressed-air system fed from the compressors in the engine room and from an additional standby compressor located under the forecastle head. Very soon afterwards one of these ships was attacked by a submarine, which scored several hits. Fourteen out of twenty-seven tanks were damaged and open to the sea, and both pump rooms were flooded. The compressed air was brought into use immediately, and pressure was maintained which enabled the ship to remain afloat until she reached dry dock, having completed a voyage of several hundred miles floating on air. Soon afterward, another ship belonging to the same company, was saved in similar fashion.

"The example set by the Eagle Oil Company, and the energy and persuasiveness of its manager, Mr. Nelson, eventually had their effect, and in 1943 a public announcement was made to the effect that the Ministry of War Transport in June, 1942, had adopted a system of using compressed air which was described as 'one of the most important and successful of the war' in the saving of ships.

"Tankers are particularly well adapted for salving by means of compressed air, and more so than merchant ships because of the great amount of subdivision by longitudinal and transverse bulkheads and because their decks and hatches are easily made watertight. In this respect there is a certain similarity between tankers and warships, which are even more subdivided and have decks at certain levels which can easily be made watertight.

"Excess pressures of seven pounds are regularly used on tankers, and excess pressures of twenty pounds were frequently used on watertight bulkheads, hatches, and doors of the ex-German battleships at Scapa. The hatches and doors were strengthened to withstand this pressure, but the bulkheads were not."

British Combine photo

GOING DOWN TO HAVE A LOOK

A diver of the British Naval Salvage Service going underwater to inspect the British destroyer H.M.S. "Gypsy" which was sunk by a mine off the east coast of England in November, 1939.

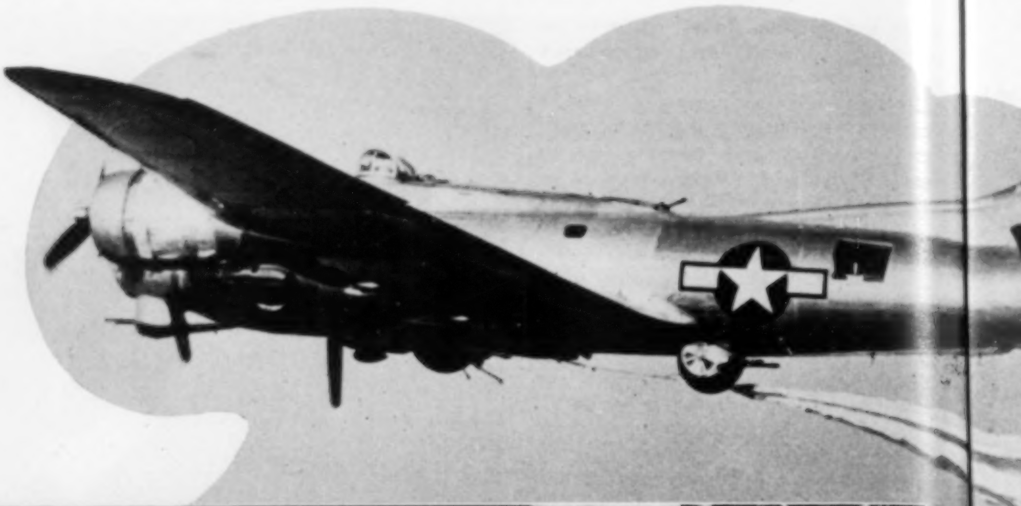
Most of the Salvage Department's activities during the first two years of the war were devoted to the saving of ships, although the enemy occasioned some harbor-clearance work by sinking Allied craft in estuaries or approaches. But it was not until the African invasion that harbor-clearance operations became a main part of the program. From 1942 on, it played an increasingly larger role in all the succeeding campaigns in Sicily, Italy, southern France, and Normandy. The availability of the ports at the earliest possible moment was of vital importance in maintaining the line of supplies, and the foe sought by every means at his command to prevent this use by blocking the entrances. In some cases ships were piled on top of one another, and in others they were double-banked in two rows. In addition, wrecks obstructed the fairways and berths, while piers and cargo-handling equipment were damaged and sunk.

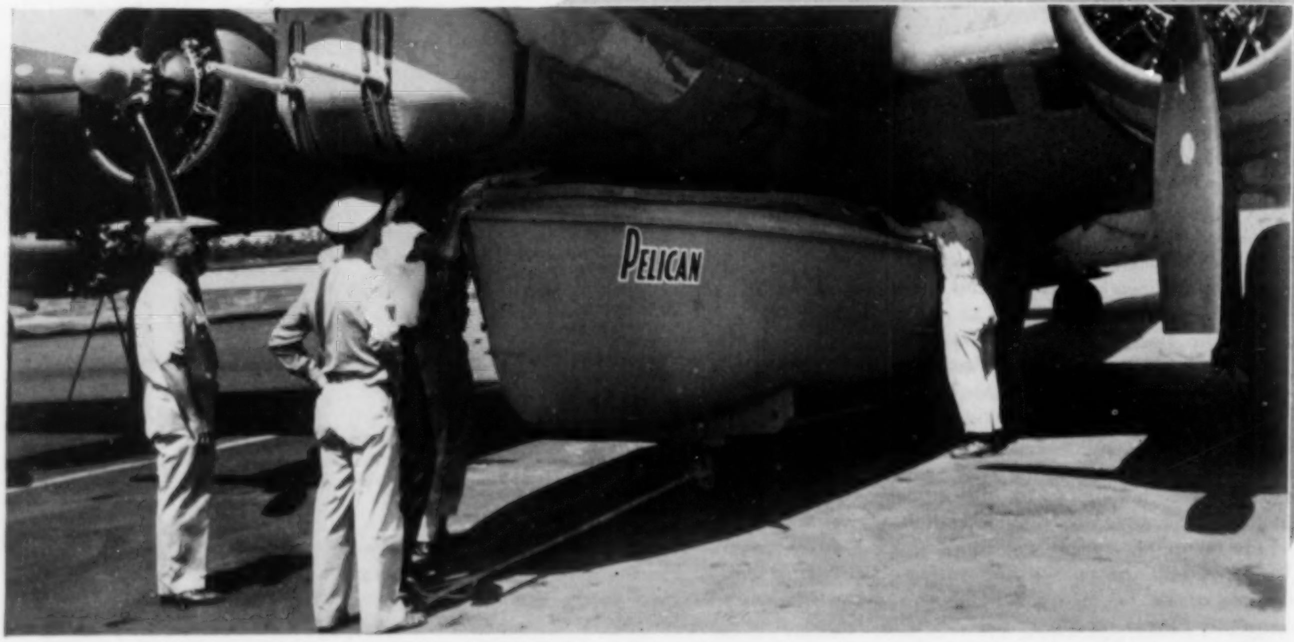
Here, again, time was a major factor. With supplies waiting to be brought forward, it was necessary for commanders to know when they could be moved up and how many docks would be available each succeeding week so that they could plan troop movements accordingly. Consequently, it was up to the salvage officer in charge to set a schedule and then to meet it. How well this work was done can be judged from Captain Polland's report on the work at Tripoli, where eleven vessels of 1000 to 5000 tons each were sunk stem to stern across the harbor entrance.

"On top of this block and on either side," said Captain Polland, "numerous small craft—barges, tugs, launches, floating cranes—were sunk in a tangled mass of wreckage. It was almost impossible to get a motorboat either through or over the top. Ships were waiting outside with supplies and equipment necessary to support the advance of the army. Five days after the capture of the port a breach had been made through the blockships wide enough and deep enough to permit the passage of LCT's onto which the ships were unloaded. On the eighth day there was a depth of fourteen feet, sufficient to allow small coasters to enter; and on the fifteenth day a vessel of 15,000 tons, drawing 24 feet of water, passed through in safety. The opening of this gap was accomplished by first demolishing one ship completely with explosives and then lifting and swinging aside two others. No special craft were available for this work."

The Flying Dutchman Lifeboat

Copeland Lake





A MOLDED plywood boat that is carried under the belly of a bomber or transport plane and parachuted to men adrift at sea is a recent addition to the equipment of the Army Air Force. Two chambers that are inflated with compressed gas right the craft if it does not strike the water right side up and afterward serve to make it virtually noncapsizable. Known as the "Flying Dutchman," this air-borne lifeboat is being turned out at New Orleans, La., by Higgins Plastics Corporation at a rate of ten a day. One of the first that was built accompanied the late President Roosevelt on his aerial voyage to Yalta.

The boat is 28 feet long and weighs 2800 pounds. Cables hold it snugly against the underside of the carrier-plane's fuselage, and its streamlined shape offers so little air resistance that the additional weight reduces the aircraft's speed by only 5½ miles an hour. It is released by the regular bombing mechanism operated either from the bombardier's or the pilot's compartment, and is catapulted away from the plane by special apparatus. As it drops, three 48-foot cargo parachutes open and support it in a harness made up of a sling with cables extending to the bow and the stern. It is held with the bow sloping downward at an angle of 40° and falls at the rate of 25 feet a second. It is usually dropped from a height of 1200-1500 feet, but may be launched from altitudes as low as 700 feet.

Detachable stern fins of wood steady the craft during its descent, and crews trained at Keesler Field, Miss., have attained remarkable accuracy in spotting it close to men who have been forced down at sea. When the boat strikes the water, the impact causes several things to happen immediately. Smoke and light signals are set off; 200-foot lines are shot out on either side by rockets so that they can be grasped by weakened men afloat; and rubber mats fore and aft are distended by compressed carbon dioxide released from cylinders. These buoyant structures not only bring the lifeboat into normal floating position but, by arching over the bow and stern upon inflation, provide protective coverings against the sun and weather.

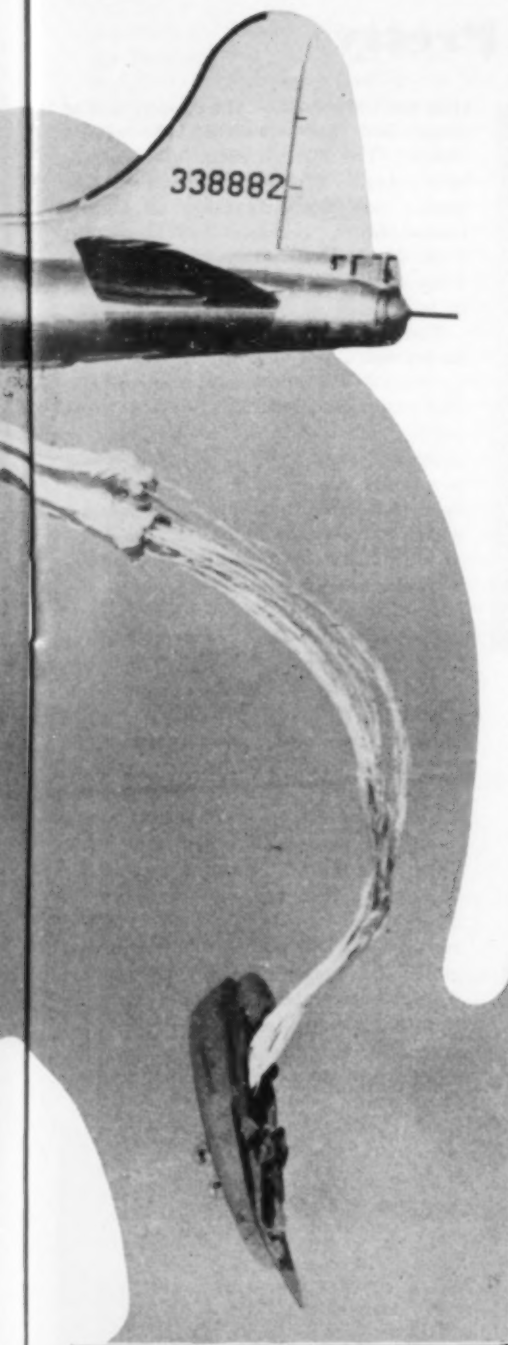
Each boat is equipped with more than 80 items. These are carried in storage lockers and include blood plasma, medical kits, food, clothing, blankets, fishing tackle, radio, signaling devices, and other necessities. Two air-cooled gasoline engines can drive the craft at a speed of 8-10 miles per hour, and enough gasoline is provided to give it a cruising range of 500 miles. Collapsible 20-foot sails may also be raised. The exhaust mufflers of the engines warm water for coffee, etc., and operate a still that converts sea into potable water. The engine cylinder heads serve as stoves for heating canned rations and for cooking birds or fish that may be caught.

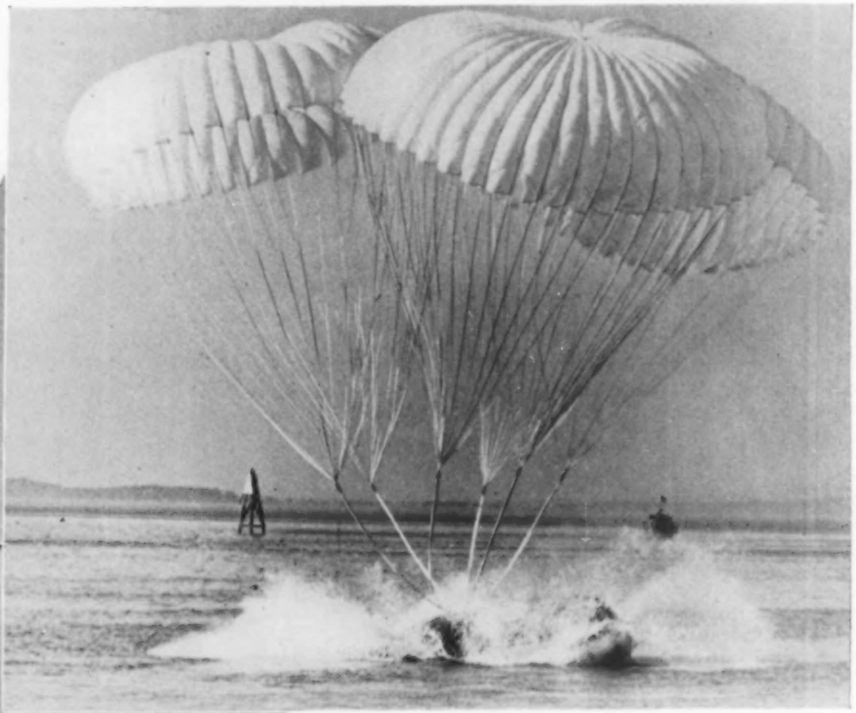
The Flying Dutchman is partly the outgrowth of a suggestion made in 1942 by Andrew J. Higgins, head of the firm that is constructing it. During the Japanese siege of Bataan in the Philippines, Mr. Higgins proposed to the AAF that a semicylindrical metal lifeboat be developed for dropping medicinal supplies, ammunition, and food to General MacArthur's beleaguered troops. He directed his company's engineers to begin experimenting with plasticized veneers and fibers to obtain shapes that would withstand the impact when dropped on to a body of water from an appreciable height.

At that time the AAF was not interested in this particular type of craft, but that branch of the service, as well as the British, later sought a droppable lifeboat of wood or plastic material. When Mr. Higgins heard about this he invited the Air Service Technical Command at Wright Field, Ohio, to send representatives to New Orleans to see the results of his investigations. That was done, and it was decided that a hull of plasticized veneer shapes, properly bonded, would stand up under the impact to which it would be subjected when dropped by parachute. After further experimental work at Wright Field, a contract for a number of the boats was awarded to the Higgins concern and a production line was set up.

Recently Capt. W. L. Dawbarn of the AAF Air-Sea Rescue Service, who was one of the officers detailed to New Orleans when the Flying Dutchman was being developed, wrote of its successful use in the North Sea shortly before the German surrender. Two hours after six fliers had been reported forced down off the coast of Denmark, a plane located them huddled on a raft. A 35-mile wind was blowing and bouncing them around like a cork in a sea.

From a height of 1200 feet the lifeboat was dropped to within 100 feet of the men, and twelve minutes later all had clambered into it and had the engines going. The storm increased in intensity and lasted for two and a half days, the wind reaching a velocity of 60 miles. Although a torpedo boat was sent to the rescue, it did not locate the craft until the third day because the wind prevented it from flying the kite-borne aerial for its radio. When there was no more gasoline left for propulsion, the boat was at the mercy of the sea, and at one stage while adrift three of the men were thrown overboard by a giant wave. They were drawn back by lines thrown to them, and all six occupants survived the ordeal.

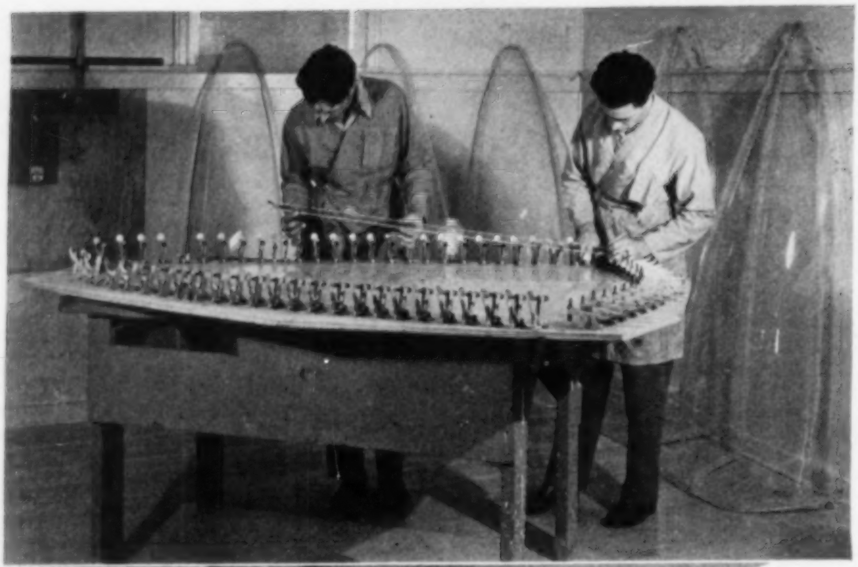


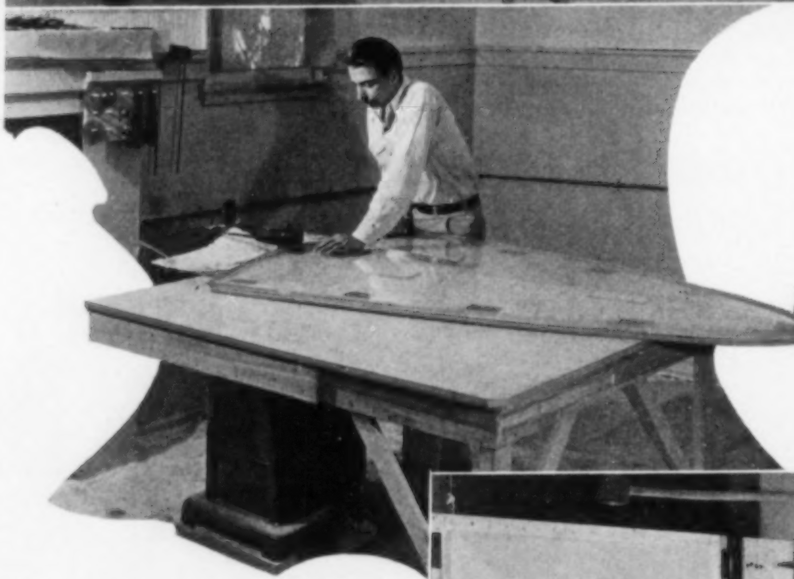


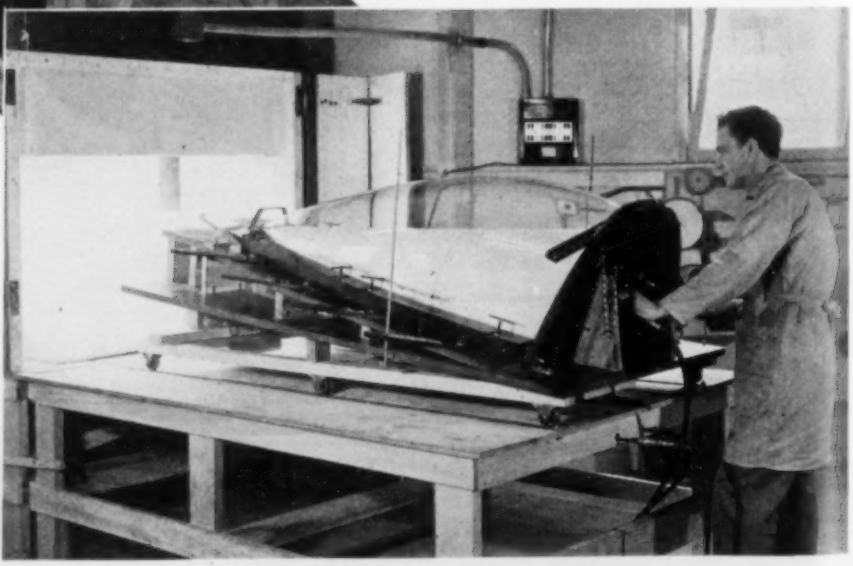
FROM SKY TO SEA

The boat is carried shackled close underneath the fuselage of a Flying Fortress (opposite page). The bomb-release mechanism catapults it away from the plane (top-center), and as it begins its descent, three trailing cargo parachutes open. It falls with its bow pointing downward at an angle of 40 degrees, and as it strikes the water (above) rubber mats over the bow and stern are inflated with compressed gas, causing the craft to right itself instantly. Aboard the well-provisioned lifeboat (left) rescued airmen raise the sails that supplement the power of two air-cooled gasoline propulsion engines.

Fighter Pilots Sitting Pretty







MANUFACTURING STEPS

Top–The workmen are holding one of the attaching strips which are cemented to the sheet by means of 72 toggle clamps. Note the finished cockpit enclosures, much like a teardrop in shape, resting against the walls. Center–While still flat, the part, with the strips in place, receives its final machining. Bottom–As it comes from the oven, the preshaped, soft "glass" is sealed tight on the blowing jig where carefully controlled air pressure gives it its final contours.

BLIND spots have for a long time been the undoing of fighter planes, in fact engineers of the aircraft industry have been trying to eliminate them ever since the first pusher dropped "rocks" during the first World War. Probably one of the most outstanding advances along this line is the "bubble" cockpit enclosure that has been developed for the American P-51 Mustang. This canopy gives the pilot 360-degree vision, an advantage in combat that even the layman can appreciate.

Both the Axis and the Allies were in full accord on one point; namely, that the rear-view mirror and periscope approach which endangered aircraft missions had to go. The Germans made the first attempt to provide a satisfactory substitute. While the enclosure on their Focke-Wulf 190 was something of an improvement, it was found that the metal supporting cradle on that type of ship not only twisted the canopy out of shape but also distorted the pilot's vision. The British came much closer to a solution of the problem, but their blister was not adaptable to United States planes. It was at that stage that Cols. Mark E. Bradley and George E. Price of the U. S. Army took the matter in hand.

Today, bubble enclosures that offer an unobstructed view are formed either by the aid of vacuum or compressed air. One manufacturer, Stack Plastics Company, has developed a free-blowing process (patent applied for) that is said to permit rigid control of the forming operation from beginning to end and without the use of molds. The material of which the canopies are made is $^5/_{16}$ inch thick and is marked, sawed, and machined to exact pattern in the flat. Attaching strips that conform in shape and size to each flat piece are then cemented on by means of 72 toggle clamps that apply equal pressure all around. After a setting period of 24 hours and more the part receives its final machining.

The enclosure in the making is now ready for the electric oven, which was designed and built by the company and is, perhaps, the most unique feature of the forming process. Through temperature control at definite points, the unit gives the plastic desired preliminary contours with the least difficulty. It is further claimed that it heats and shapes the component parts at one time, thus eliminating the spring back common to conventional free-blown work. Following heating, the "glass" is tested for pliability and goes by trolley to the blowing jig, care being exercised during handling to prevent scratching the softened material. Toggle clamps hold the assembly securely in place and also serve to effect an airtight seal.

Positive air pressure is used by the Plastack method rather than vacuum to give the part its final form because it enables the operator to check the work during blowing and to control the air pressure the entire time. This, together with temperature modulation in the oven, makes it possible to produce a canopy with the desired center-line contour. Several points are used for checking, and a skilled operator can maintain the necessary contour at all of them. The enclosure is kept under pressure until it is cool enough to be removed for inspection and final checking. If it passes, it receives a protective coat to prevent marring the surface and is then ready for shipment to the plant where the type of plane of which it forms a vital part is built.

Robot-Messenger Service

RECEPTACLES that look something like letter boxes constitute the transmitting end of an electronic communications system by which messages can be deposited at one point and received at another. The transmitter is installed in a public place or office building, and when a person wants to send a telegram he presses a pushbutton on the machine and starts the initial chain of operations that eliminates the messenger boy.

First a blank of Teledeltos dry recording paper is drawn from a supply roll at the receiving end in the telegraph office and wrapped on the recording drum. Next, the words "Deposit Telegram" appear in a window in the transmitter. Special blanks measuring 3x7½ inches are used with the system, and the insertion of the typed or written message in the slot sets the sending and receiving mechanisms in motion. As the telegram is pushed down in the transmitter it is wrapped around a revolving drum above which travels a carriage mounting a photoelectric cell. The latter scans the message and at the same time actuates the stylus that duplicates it at the receiving end.

At the telegraph office, the telegram is automatically stripped from the drum and deposited in an open chute in the receiver housing. The operator picks it up and reads it and, if he is satisfied with it, notifies the sender to that effect by lighting a signal, "Telegram Accepted—Thank You," on the front of the transmitter. He does this by means of a toggle switch. However, he can get another recording of the message if he wishes it. The original blank drops into a locked drawer in the transmitter for periodic removal. Both units are driven by synchronous motors on 110-volt, 60-cycle alternating current, and it is claimed that they can handle a telegram of perhaps 200 words in approximately two minutes. The system has been developed by the Western Union Telegraph Company and has been given the name of Telefax.

Pneumatic Lift Speeds Output of Vacuum Coating Machine

PARADOXICAL as it may seem, salt films are deposited on glass to increase its light-transmitting qualities by minimizing reflection. Photographic lenses, for example, with a coat of magnesium fluoride a few millionth of an inch thick will improve contrast and enhance the clarity especially of colored pictures. However, glass is but one of a number of materials that are being given extremely thin films of varying salts or metals for a diversity of purposes. Nearly all the base and precious metals and their alloys are included among the latter, and are being deposited on other metals, ceramics, plastics, wood, leather, textiles, etc. The field of electronics, especially, has created a great demand for work of this kind because it has been found that some of the components such as resistor units and piezoelectric crystals assure more intimate electric contact when so treated.

There are different methods of application. By one, the articles to be coated are subjected to a high vacuum and the coating material is heated electrically under conditions that will cause it to evaporate, to stream upward, and to deposit itself on the exposed surfaces. The accompanying illustrations show the latest model of a machine of this type developed by Distillation Products, Inc. The work is held in a special fixture above the melting unit, all of which are inclosed in a glass bell jar that is raised and lowered by a pneumatic device operated with compressed air at a minimum line pressure of 40 pounds.

The working parts of the coating machine are housed in the cabinet and consist essentially of a vacuum pump and of an oil diffusion pump. The latter can be kept running through the medium of a valve, and enables the operator to reduce the pressure in the jar from atmospheric pressure to approximately 0.00002 millimeters of mercury in five minutes or less, depending upon the size of the vacuum pump used. Complete evaporation or deposition is effected in from one to two minutes and is generally indicated on the product by a change in color.

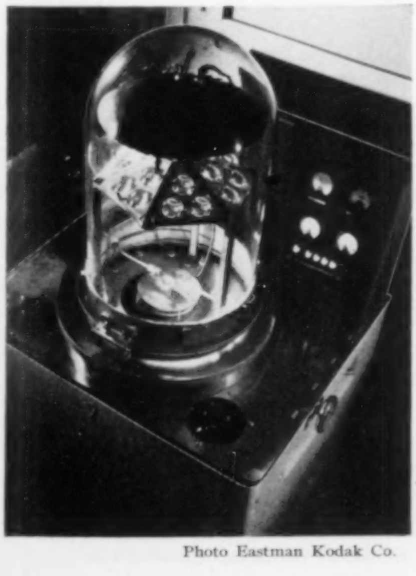
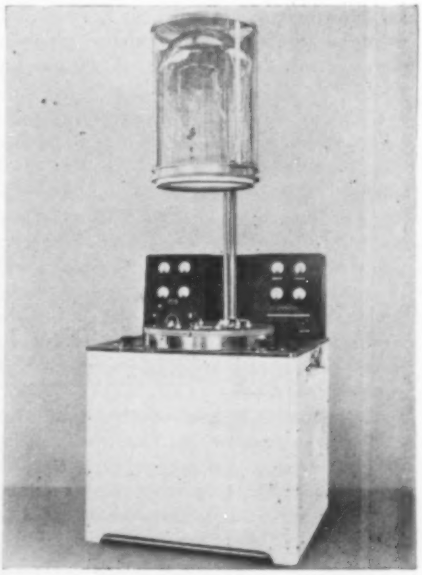


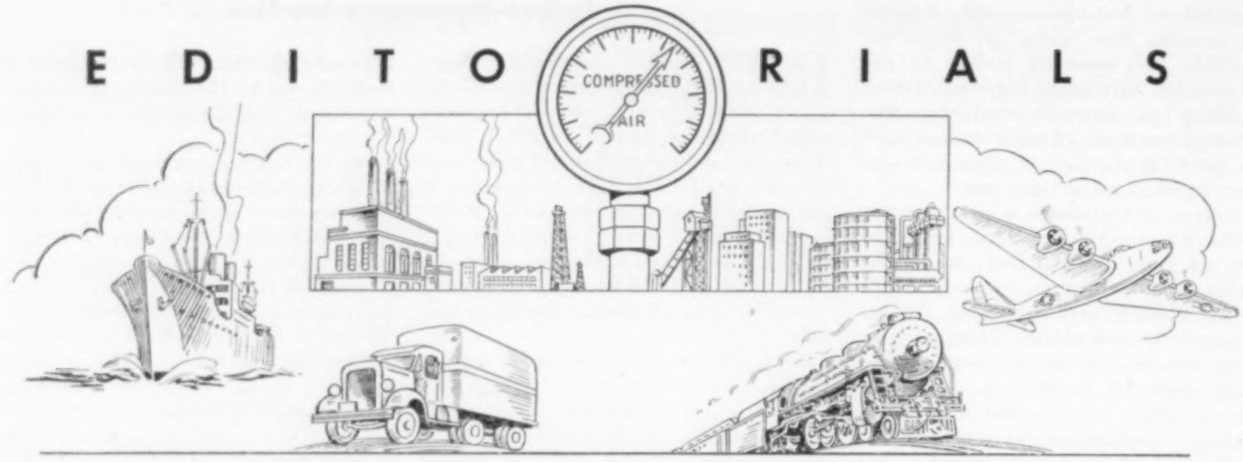
Photo Eastman Kodak Co.



EVAPORATION METHOD

At the left, he machine is shown coating photographic lenses with a transparent film that minimizes reflections between lens surfaces and thus dispels ghost images. Note the special fixture in which the work is held above the electric element and the crucible, which is heated sufficiently to vaporize the coating material. The apparatus is provided with a pneumatic lift that is actuated by turning the lever at the right side of the housing. This facilitates raising the bell jar for the removal of finished work and lowering it after reloading. The unit is equipped with Pirani and ionization gauges that give direct readings in microns and millimeters of mercury of the pressures in the vacuum chamber. These, together with temperature gauges, switches, etc., are located on the back panel and worktable for ease of operation.

EDITORIALS



NILE-CONTROL PROJECT

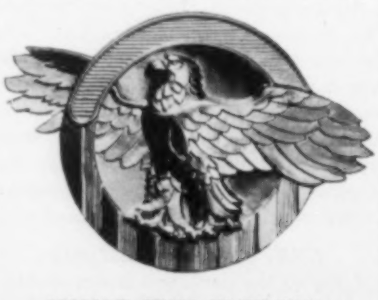
THE heightening of the Aswan (or Assuan) Dam on the Nile River is proposed as one step in a scheme for providing greater flood protection in Egypt. If the dam is made higher, it will be the third time this has been done. As originally built in 1902 it had an elevation of 357 feet, was raised in 1912 to 374 feet, and again in 1933 to 403 feet. The current plans call for increasing its height to 439 feet and its impounding capacity from four million to more than seven million acre-feet.

It was suggested in 1932 that additional works be constructed to take care of Nile floods, but they were not undertaken because the river was in a cycle of predominantly low maximum flow. Meteorological data compiled since 1869 show that there are alternating periods of low- and high-flood values. During the first 30 years in which records were kept there were nineteen dangerous floods, while in the following 39, up to 1937, there were but six. Since then there have been three more, indicating that the high cycle is beginning.

All of Egypt is below the flood level of the Nile, so there is a strong demand for greater protection. In spring and summer the river stays within its own channel, but at other seasons it may rise 20 feet or more and all that then keeps it from overflowing are man-made banks that extend from Aswan Dam to below Cairo and thence along the two branches of the stream as it makes its way through the delta to the sea. In lower Egypt the river runs about 10 feet above ground level during ordinary high water, and from 2 to 4 feet higher during exceptional floods. A break anywhere in the levees would take hundreds or thousands of lives and do millions of dollars worth of property damage.

Raising the height of the dam also involves increasing its thickness. The first lift was added according to a plan devised by Sir Benjamin Baker. By means of it, a 6-inch gap, known as the Baker space, was left between the old and the new masonry, the two being tied together by means of steel rods. The gap was subsequently filled with clean, broken granite. Then, after a sufficient lapse of time to allow for settlement and the equalization of temperatures, the intervening space was thoroughly grouted to form a single monolithic structure. The second heightening was accomplished by dressing off the downstream face of the existing dam and constructing masonry buttresses in sliding contact with it. Noncorrosive steel plates were introduced to assist the sliding action. It is now proposed to demolish these buttresses and again increase the thickness of the structure by the Baker method.

In conjunction with the proposed work on the dam, it is planned to construct a channel from Aswan Reservoir to a neighboring large depressed area, the Wadi Rayan, and use the latter as a storage space for excess water.



HONOR THIS EMBLEM!

Honorably discharged World War II veterans wear an old-gold lapel button bearing this design. Every patriotic citizen should learn to recognize it and not confuse it with badges of lodges or other social organizations. The emblem was won the hard way by approximately a million men who are now returning to civilian life. Some of them gave up a leg or an arm for it; others brought home shattered nerves. Even those who are in perfect health will find it difficult to adjust themselves to the change in daily routine and the let down from regimented army life. Let's show them the respect and consideration they so richly deserve.

POSTWAR AIR TRANSPORT

THE extensive use of airplanes in the war and the concurrent improvement in flying craft that has inevitably accompanied their widespread application have removed any lingering doubts that anyone may have had as to the future of air transportation. The era of flying is here, and even now far-flung plans are being made by numerous air-transport concerns to criss-cross the globe with routes to be flown on regular schedules. Keen competition among the companies of various nations, as well as those of individual countries will, for a time at least, bring low fares that are bound to entice the traveling public.

Within our own borders, established air lines are mapping out huge expansion programs. Nineteen domestic companies have ordered or obtained options on 409 new planes with a combined seating capacity for 23,275 passengers. These will bring their aggregate air fleet to 975, with accommodations for 36,180 persons. By contrast, these same lines operated 359 planes with 6250 seats before the Pearl Harbor attack. After the Army and Navy had taken over half their equipment, they were left with 166 ships, but this number has been increased since then to 395 through recoveries and additional purchases. The enlarged fleet of 1946-47 will, according to the Air Transport Association, be capable of covering six to eight billion passenger miles annually, or three to four times the 1944 figure.

The new planes now on order will cost around $300,000,000, and expenditures during the next five years, including those for ground equipment, are expected to reach $750,000,000. More than 200 of them are to be of the 4-engined type, and many of them will have cruising speeds of 300 miles an hour or more, with much the same provisions for passenger comfort as are now found on trains. Trips of up to 225 miles will likely be made on such frequent schedules that no reservations will be necessary, and taking a plane will be almost as simple as boarding a trolley car.

This and That

Simon Lake Dies

Simon Lake, one of the inventors of the modern submarine which depends upon compressed air for its operation, died June 23 at Bridgeport, Conn., at the age of 78. During the first World War, a company headed by him built 100 undersea craft of his design for various nations, 55 of them for the United States. Mr. Lake originally conceived the submarine as a commercial vessel, intending it for salvage purposes. To that end he constructed a crab-like type with wheels by which it could move on the ocean floor.

Mr. Lake's first underwater boat, the *Argonaut*, was built in Baltimore, Md., in 1894. It was not designed for military use. A few years later the American Navy asked for proposals on submarines, and Mr. Lake submitted designs. To prove the worth of his craft he asked permission to approach the mine field guarding Fort Henry to sever, without detection, some of the mooring cables. The Navy denied him this request, but he went ahead anyway and reached the center of the mine field without being observed.

Our Navy Department turned down Mr. Lake's plans and accepted those of John P. Holland, who constructed our first submarines. Mr. Lake built the *Protector* in 1901, but when it did not receive favorable consideration here he went abroad and sold it to Russia. He spent some years in Europe designing and constructing undersea craft and serving as a consultant. After his return to the United States he founded the Lake Torpedo Boat Company in Bridgeport, Conn., and built submarines for this country and Austria. Afterward our Navy Department constructed vessels of his type in its own yards. One of the principal features of the Lake boat was that it could submerge on an even keel, which contributed greatly to safety in diving.

Despite the submarine's successful use in warfare, Mr. Lake kept trying to exploit it for commercial and salvage purposes, and at one time endeavored to launch a project for recovering treasure from the ill-fated *Lusitania*. He was also instrumental in developing the diving bell, another feature of his submergible by which men could leave the craft while on the sea bottom to harvest its riches or to work in sunken ships.

* * *

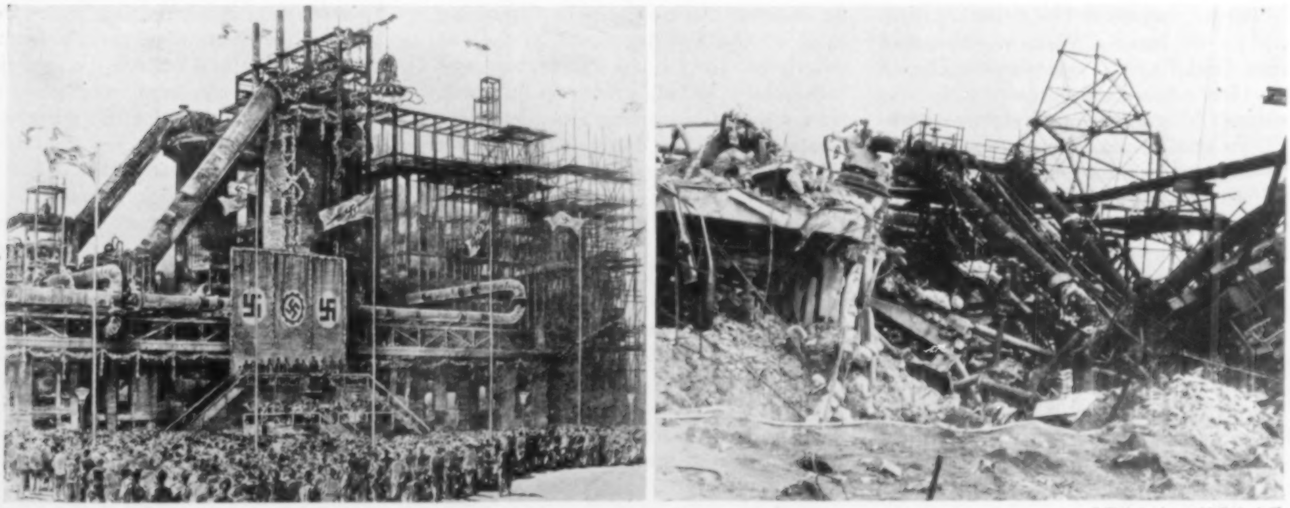
German Synthetic Gasoline

At one time Germany was making synthetic airplane and motor fuel at the rate of four million tons a year, according to investigators who have visited that country since the surrender. More than 95 percent of those fuel plants were put out of commission by bombing, although all of them were being moved underground when the Nazi collapse came. A technical mission of 22 men was sent to Germany as soon as hostilities ceased to inspect the works and gather information on their operation. The plants were so nearly destroyed that little could be learned from them, but facts of value to research in the United States were obtained from technicians formerly employed in them. Hidden plans and engineering data also were unearthed, among them a complete description of a hydrogenation plant that had been buried by the man who wrote it. It is stated that the Germans produced a fuel from which gasoline of 90-95 octane rating could be made by adding tetraethyl lead. While sufficiently high for the type of aircraft engine used by the Germans, it fell considerably short of our own gasoline of 100-octane rating or higher.

* * *

Small Testing Gauge

A wire-testing gauge no larger than a paper clip has been an important tool in the building of war materials and promises to give equally valuable service in postwar industrial research. Known to scientists as the "SR-4" strain gauge, it was the subject of a recent 3-day conference of research and testing authorities in Washington. The meeting was sponsored by the Southwark Division of the Baldwin Locomotive Works, which makes the instrument, and its purpose was to enable those attending to exchange information on the uses to which it has been put and thus further postwar research. By cementing the gauge around the barrel of a gun it is possible to record the amount of strain that takes place during firing. In a similar manner it will reveal points of weakness in ships during construction or operation and permit making corrections. Applied to any part of a bridge, the instrument indicates the impact of moving traffic and shows where the greatest structural strength is needed. It is believed that



Official photo U.S.A.A.F.

BEFORE AND AFTER

The drawing at the left, found by American photographers, shows the flag-bedecked synthetic-oil plant at Rothensee, Germany, at the time it was opened in 1937. Until Allied bombers got busy, this refinery produced 36 million pounds of gasoline and fuel oil a month—4 percent of Germany's synthetic-fuel output. There were 2300 employees, of whom 40 percent were enslaved civilians from captured countries. The same plant is pictured at the right as it looked when our invading troops reached it. The damage was done in thirteen daylight bombing attacks by British and American airmen. The wreckage is such that the plant flow can no longer be traced.

the gauge will be helpful in determining the strength and efficiency of new light construction materials now under study.

Signal Corps photo

JUMBO HELPS RUN A RAILROAD

An 80-year-old elephant shown pushing a boxcar on a siding of the Bengal & Assam Railway near Ledo, India. This section of the line is operated by the Military Railway Service of the U. S. Army. The elephant can push several loaded cars at a time and has made it possible to do away with a shunting engine.

* * *

Butte's War Record During the four war years, 1941-44 inclusive, Montana mines and smelters yielded nearly five billion pounds of minerals and related products needed to aid our fighting forces. The output of zinc was in excess of 1,700,000,000 pounds, and copper production also topped the billion-pound mark. Other principal materials taken from the earth were lead, manganese, cadmium, arsenic, superphosphate fertilizer, silver, gold, and sulphuric acid. The major proportion of the metals came from Butte, famed as the richest hill on earth. Although the latter's population is considerably lower than it was during World War I, the camp is still important enough to wield a big influence on the outcome of the war. By way of example, just one of its mines has produced a considerable percentage of our total requirement of manganese during the emergency. From 1862 through 1943, a period of 82 years, Butte turned out the astounding total of more than $3,000,000,000 worth of minerals. Copper, zinc, and lead, in the order named, were the leading products. Butte's mines are now so deep that heat is a problem, but it is being combated by effective ventilating and air-conditioning measures, and many more productive years for the camp are envisioned.

* * *

Potato Gold Rush Potatoes were so scarce in Canada the forepart of July that they brought fancy prices in black-market dealings. When word spread that Fred Fayer, a farmer near Hamilton, Ont., was digging his crop, he was stormed by a throng of potatoless people. They came in autos and on foot, some of the women pushing baby carriages. A self-service market was set up and the customers followed Fayer's tractor plow, gathering up the tubers as they were unearthed. They paid him and left. "A gold rush had nothing on what happened here," he commented later.

* * *

Brazil's Steel Plant As described in our October, 1942, issue, the National Steel Company of Brazil is building at Volta Redonda the first integrated steel plant in South America. The expectations were that it would be operating before now, but low priorities on essential equipment made in the United States and shortage of shipping have delayed its completion. The coke ovens, blast furnace, and other major features are now substantially finished, and an entirely new city of 30,000 persons has arisen at the mill site, with 16,000 of them engaged in the construction work. The development of coal deposits in the southern state of Santa Catarina to supply the mill with 26,000 tons of coking fuel a month is also in its final stages. When running at full capacity, the plant will use daily 10 percent more gas and ten times more water than are now consumed in the leading Brazilian city of Rio de Janeiro. In addition to furnishing most of the building material for the enterprise, the United States has sent technicians to help erect the mill and, later, to assist in training Brazilian labor to operate it. No date has been set for the production of steel.

* * *

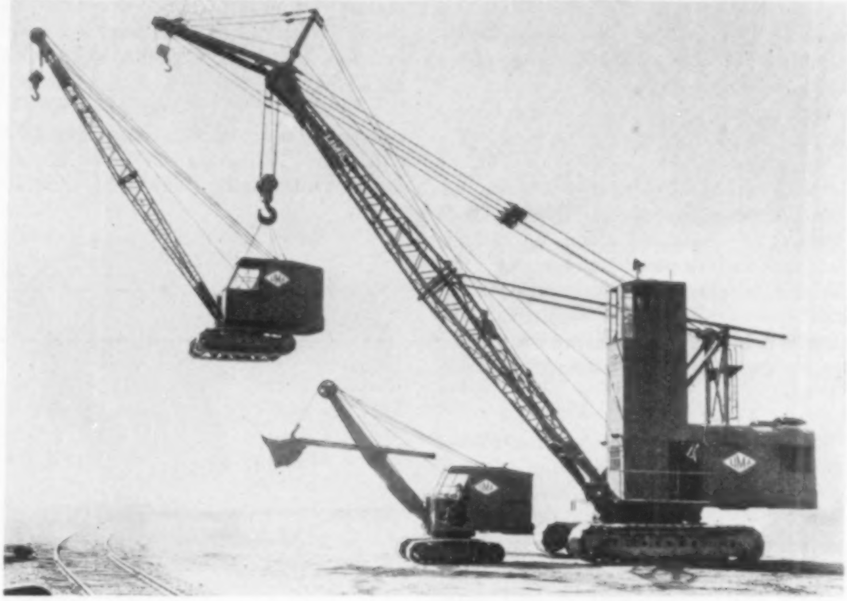
Powder Aids Oil Drillers A high-temperature powder that has heretofore been made exclusively for military purposes has been released for use by the petroleum industry and is expected to result in the speedier and less hazardous drilling of deep oil wells. As an aid to production, the casings of such wells are sometimes perforated by guns made especially for the purpose. Powders previously available could withstand a temperature of only 305°F., which is exceeded in some wells more than 8000 feet deep, notably in those along the Gulf Coast. Attempts to use it in such wells have resulted in premature explosions that have damaged them and caused delays or losses in production. The new powder will safely withstand the highest temperatures yet encountered in an oil well. It is manufactured in only one factory, the war-born Radford Ordnance Works at Roanoke, Va.

* * *

Weeding with Flames Experiments indicate that the killing of weeds with fire may become accepted practice in connection with the cultivation of certain farm crops. Propane and butane, two gases obtained from petroleum, seem to be the most suitable fuels for the purpose. Compressed and liquefied, they are widely used as "bottled gas" for cooking, heating, and refrigeration in rural districts and other communities remote from gas-distribution lines. Because they are at present essential to the operation of many war plants, their employment for weed killing has been restricted, but the Petroleum Administration for War has recently made available limited quantities of propane for further experimentation in that field. Some of the best results obtained with the gases have been in the cotton and sugarcane fields in Arkansas, Mississippi, and Louisiana. Flame weeders work on the same principle as battlefield flame throwers, and an apparatus that will project fire over two or more rows of growing crops at the same time has already been manufactured experimentally.

Powerful Crane Completely Air Controlled

COMPRESSED air controls all the normal functions of the new Type 2000 crane of the Lima Locomotive Works, Inc. The machine has a boom of 60 feet, necessitating an exceptionally high operating tower, and has a lifting capacity of 100 tons. When equipped as a shovel it can handle 5 cubic yards of material. It is powered with a diesel engine or electric motor, and the air is supplied by a compressor driven by V belts from the engine crankshaft. The air is delivered to a main receiver, where it is stored at a pressure of 150 pounds per square inch. From there it passes through a reducing valve to an auxiliary reservoir, where a working pressure of 80 pounds is maintained, and thence to a manifold at the control station in the tower.



THE LARGEST AND THE SMALLEST

From his station high in the tower the operator controls all the normal functions of the huge crane and shovel by means of air valves.

The air valves are of the graduating and compensating type within easy reach of the operator's hand and enable him to actuate the master clutch on the engine, to propel and steer the crane, and to hoist, swing, and lower the boom. In addition, compressed air is used to control the main and auxiliary hoist brakes. The valves for this purpose also are of the graduating and compensating type and are operated by foot pedals. The entire system of piping connecting the auxiliary receiver, manifold, valves, and air cylinders is of extra-strength copper tubing and located where it is not exposed to the ordinary hazards of rough usage to which equipment of this type is subjected.

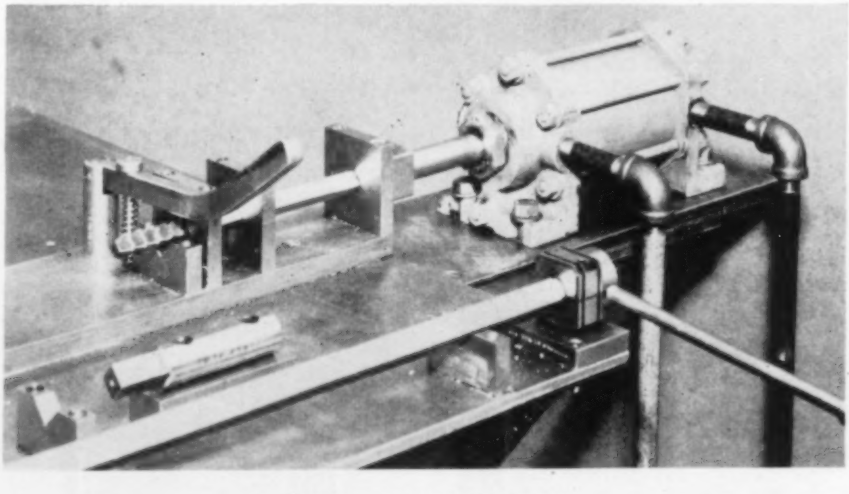
How a Workman Solved a Broaching and Sizing Problem

IT IS no unusual thing for an operator who finds difficulty in doing a certain job to devise a method by which it can be done easier and perhaps better. We have another instance of this in a device developed by an employee at General Electric's Schenectady Works for sizing and removing burrs from the inside of square tubing. Information about the equipment has been given out by the company for the benefit of others who may have similar work to do and are having trouble with it.

The frame members are about ½ inch in outside dimensions, have walls $^1/_{32}$ inch thick, and are cut into 19-inch lengths. Next, a number of holes is drilled in them, causing the formation of burrs. One of these is approximately ½ inch from the open end of the tube and must be removed to permit inserting a steel shank to a snug fit in the tube. The latter also must be sized because the square stock has a tendency to vary slightly.

By the new procedure, the frame member is placed in V blocks mounted on a steel table. These position the tube so that it slides easily over a broach, which is likewise mounted on the table and is about $^1/_{16}$ inch smaller in size. The work is held firmly by a hand-operated lever, which also exerts pressure on that part of the tube where the burr is located, thus wedging it against the broach. The latter is then withdrawn quickly, causing its cutting edge to shear off the burr. The broach is actuated by a double-acting pneumatic cylinder which, in turn, is controlled by a foot valve.

The frame member is then checked for size by putting it on another set of V blocks and sliding it over a gauge. If it is found to be undersize it goes on a third set of V blocks where it is held while a cam-type device is introduced in it and expanded sufficiently by depressing a hand lever to give the tube the required inside dimensions.



DEVISED ON THE JOB

The table-mounted equipment that facilitates the removal of burrs from inside square tubes and sizes the latter. From back to front, foot-controlled air cylinder that operates the broach; V blocks and gauge for checking internal dimensions; and fixture by which undersize tubing is expanded preparatory to inserting a steel shank.

Industrial Notes

Toronto, Ont., is planning to build a subway, the first in Canada, at an estimated cost of $51,000,000. The project is to be started after the war and will involve both underground and open-cut work. The line will be 9 miles long.

Underground storage of surplus helium is being resorted to by the U. S. Bureau of Mines as a means of conserving that rare noninflammable gas. The helium is extracted from natural gas that is distributed for industrial uses and is being forced back into the ground at eleven wells in the Amarillo District, Texas.

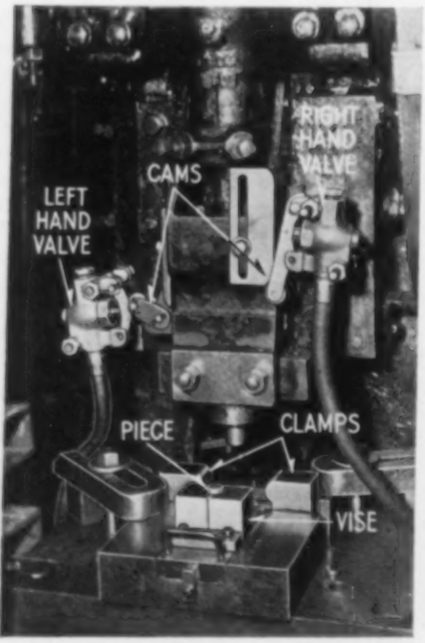
Seep-Seal is a new compound offered by the Rock-Tred Corporation for leakproofing underground concreté structures such as mine shafts, foundations, reservoirs, etc. The material is applied to walls where there is slight seepage, or, mixed with cement, may be used to seal holes or cracks while water is actually pouring from them. It is claimed to stop leaks in two minutes.

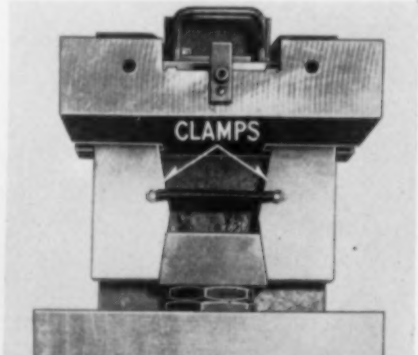
An improved type of air-operated rivet shaver that is not hampered in its work by wrinkled surfaces has been announced by the Pfahler Manufacturing Corporation. The 33 Shego Finisher, like the earlier model, is designed primarily for building airplanes which, if they are to give best performance, must be structurally sound and have smooth exterior surfaces. The new tool is designed to take one of a series of interchangeable end-mill cutters ranging in diameter from $^5/_{16}$ to $^9/_{16}$ inch and to shave projecting heads of aluminum-alloy rivets until they are flush with the metal plating. Closely encircling the cutter is an adjustable stop that accurately controls the depth of the cut, that can be locked in position, and that is provided with a plastic guard ring to prevent damaging the sheathing. A stabilizer, consisting of two spring-loaded telescoping legs with friction pads, steadies the finisher during machining and compensates for surface irregularities in the skin. The Model 33 measures 3x5x7 inches and weighs 4 pounds, complete. It is driven by an air turbine and uses 8 cubic feet of free air per minute at 90 pounds line pressure—the minimum for efficient use. The exhaust air from the turbine acts on the injector principle and draws air from the outside into the stop around the cutter, thus ejecting the chips. To keep the work area clean, the cuttings can be confined in a collector clipped on the outlet of the exhaust manifold.

Pumpcup gaskets, made originally only for reciprocating-pump cylinders, are now available in three grades for hydraulic and pneumatic cylinders. They are of external-flange design with a center hole in the web and molded of a fabric-reinforced composition that is said to be resistant to water, alcohol, glycerine, and oil and to operate satisfactorily at temperatures from minus 75 to plus 350°F. Outside diameters range from 1 to 20 inches.

Under the name Pressuregraph, Electro Products Laboratories, Inc., is offering a linear pressure-time-curve indicator for internal-combustion engines, pumps, air lines, or other inclosed pressure systems. It is an electronic device that is designed to measure either static or dynamic pressure by means of a pick-up section that is inserted in the cylinder, chamber, or air pipe. The pick-up response is amplified and transmitted to and indicated on the screen of a cathode-ray oscillograph. The instrument requires but a single control to operate it and one adjustment to compensate for temperature effects.

Rubber-lined tumbling equipment and a new lump material made of Neoprene impregnated with 150-grit aluminum-oxide abrasive can be obtained from the De Burr Barrel Company for finishing both hard or soft metal parts. The material is used dry and serves the twofold purpose of grinding and polishing, doing the work without peening or scratching, it is claimed, because of the cushioning effect of the synthetic rubber. Lumps range in dimensions from about ⅛x⅛ to ½x⅝ inch and come in both hard and soft grades. Attrition averages ½ percent after 24 hours of use. The product has been named De Burrettes.

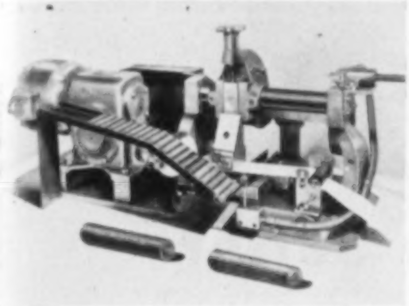




NO HAND-LOCKING

These pictures show a riveting press (left) with a sliding vise that is automatically locked and released through the movement of the ram. The work is placed in the vise, which is then pushed back between the clamps. These are brought to bear against the vise jaws as the ram moves downward and admits air into the pneumatic cylinder (right) through the medium of the right-hand cam and valve. As the cylinder piston travels upward it spreads the bottom of the pivoted clamps, causing them to hold the vise with a plierlike grip. After the piece has been riveted, the ram moves upward and operates the left-hand cam and valve, thus exhausting the air in the pneumatic cylinder and releasing the clamps. The operator then pulls the vise forward, removes the finished work, and puts in a new piece. The pictures are reproduced through the courtesy of the Westinghouse Electric Corporation.

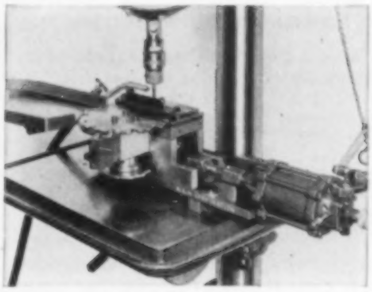
For marking cylindrical and tubular arts of hard plastic where the lettering as to be distinct, The Acromark Comany has devised a hot-stamping mahine that involves the use of pigment ransfer tape. It was developed priarily for printing control directions on andles of lethal war weapons when xisting methods were found to be indequate for the purpose. The apparatus s motor driven and consists mainly of heat regulator and of a heating head ontaining two cartridge units which, in turn, heat an engraved steel die. The transfer tape is carried by automatic feed rolls between the die and the tubular part, which is conveyed by an inclined chute and put in the stamping position either by hand or automatically. When finished, the work is removed by an air ejector. The markings are in white, which stands out prominently on dull, dark surfaces, and are applied, it is claimed, without breaking the brittle material.



For pressures up to 2500 pounds per square inch, Goetze Gasket & Packing Company, Inc., has developed a Monel gasket that works on the principle of bellows—hence the name Bellowseal. It is made up of two thin disks that are partway serrated and are bonded together along the outer periphery by welding, leaving a narrow aperture between the plates. This permits line pressure to enter and to expand the gasket, the seal becoming tighter as pressure increases. Rings of thin asbestos sheet packing are placed between the serrations and the pipe flanges at the time of installation. It is claimed that gaskets of this type have repeatedly been subjected during testing to more than 35 times normal expansion, which ranges from 0.005 to 0.01 inch, and to cycle changes from zero to 600 psi. steam at temperatures up to 850°F. without leakage even though the bolts were only finger-tight at zero pressure. A further advantage is resistance to corrosive hot gases and liquids.

In crowded areas, where the only room for expansion is upward, tanks for the storage of liquids can, it is said, be considerably increased in size by a method developed by Stacey Brothers Gas Construction Company. By its system of elevation, an old tank is used virtually as it is, together with the foundation. This is done by cutting the structure at the base and building a new shell around it of as many rings as may be required to give the holder the capacity desired. When the outer structure is finished, water is run into the original tank up to the top level of the new shell and compressed air is introduced to lift the tank to the new height. There the structure is held steady to within $^1/_{16}$ inch by various controls while 4-inch filler plates are inserted between the two shells and the units are tack welded in place. When the air is released and the water withdrawn, the filler plates and shell sections are seal welded on the outside. Inside, the old tank is trimmed and welded at intervals circumferentially. This "booster" method makes it possible, it is claimed, to give a tank an increase in capacity of as much as 100 percent.

Development of a new type of pneumatic holding fixture for various machining operations has been announced by the K & H Corporation. While originally designed to eliminate difficulties encountered in tapping heat-treated aircraft parts, it is also applicable to such work as drilling, reaming, countersinking, and milling. The assembly is mounted on a frame and consists of a double-acting air cylinder, of a plunger that is hollow for effective chip disposal, of a pawl and indexing mechanism, and of a cam. Line pressure of 35 to 40 pounds is used and increased by means of the 3-to-1 ratio cam operated by the pneumatic cylinder, which gives an additional increase in power over the regular shop-line air pressure of 4.9 to 1. The indexing mechanism is actuated by the return stroke of the piston. It is claimed that the fixture enables one operator to tap more than 18,000 one-quarter 28NF3 aircraft nuts in an 8-hour shift.



FONTANA DAM, HIGHEST IN EASTERN UNITED STATES

Authorized in December, 1941, as a war emergency measure, Fontana Dam has been built by the Tennessee Valley Authority on the Little Tennessee River in western North Carolina. Rising 480 feet above the lowest foundation rock, it is the fourth highest dam in the world. Two 67,500-kw. generators in a powerhouse at its base are now operating, and a third has been authorized but its construction deferred. The reservoir is 29 miles long and has a shore line of 274 miles. The river flow averages 3600 second-feet and ranges up to 129,000 second-feet in flood periods. The dam site was 30 miles from the nearest town and it was necessary to build access roads and provide housing facilities for 5000 workers. The 2,800,000 cubic yards of concrete in the dam was placed in twenty months, the best day's record being 10,755 cubic yards. F. C. Schlemmer was project manager.

Industrial Literature

The A B C of Power Factor is the title of a 20-page bulletin issued for free distribution by Electric Machinery Mfg. Co., Minneapolis 13, Minn.

National Foremen's Institute, Deep River, Conn., announces the publication of two new booklets, *What the Foreman Needs for Success*, and *How to Train Your Assistants*. Copies are available at 25 cents each.

Modern shipping containers that promote quick packing of industrial products are described in a pamphlet, *Your Product—How to Ship It Safely at Lower Cost*, which may be obtained from the Wirebound Box Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

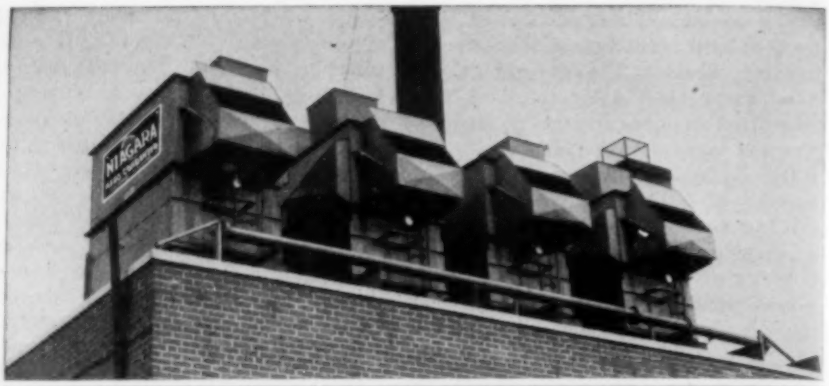
A folder issued by the George Scherr Company, 200 Lafayette Street, New York 12, N. Y., describes the Scherr Magne-Blox used for holding various kinds of work for surface-grinding operations. These blocks are placed upon the plane surface of a magnetic chuck and obtain their holding power through conduction.

An engineering bulletin dealing with "AQ," (Aircraft Quality) gears is offered by Foote Bros. Gear & Machine Corporation, 5225 South Western Boulevard, Chicago 9, Ill. This type of precision gear was developed by the company prior to 1940, but so far the output has gone into war equipment, and information on design and production methods has not been published previously.

A new book published by the National Forge & Ordnance Company, Irvine, Warren County, Pa., describes the methods by which that concern makes finished steel forgings. Text and photographs trace the processes from the making of the steel in an electric furnace through the forgesmithing and heat-treating stages to finish machining. Copies are obtainable from the company without charge.

The U. S. Department of Commerce is now offering for public distribution a 200-page booklet entitled, *Establishing and Operating a Metal Working Shop*. It was originally prepared at the request of the Armed Forces Institute for use in the Army Education Program. It is the first in a series of publications by the department's Bureau of Foreign and Domestic Commerce for the guidance of persons desiring to establish business enterprises of their own. Copies are available for 35 cents each from the U. S. Government Printing Office, Washington 25, D. C., or from any field office of the Department of Commerce.

Wartime Technological Developments is the title of a 400-page monograph compiled by the Bureau of Labor Statistics of the Department of Labor for the Subcommittee on War Mobilization of the Committee on Military Affairs of the United States Senate. A large part of the contents consists of nearly 1500 abstracts from 1942 and 1943 issues of technical and business magazines describing new products and new ways of doing things that have contributed to the war effort. This magazine was one of the sources that was drawn upon. Many of the ideas presented can be adopted by manufacturers for peacetime use. A digest of similar material published in 1944 is in preparation and will be issued as a supplementary volume. The monograph is available at 50 cents a copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.



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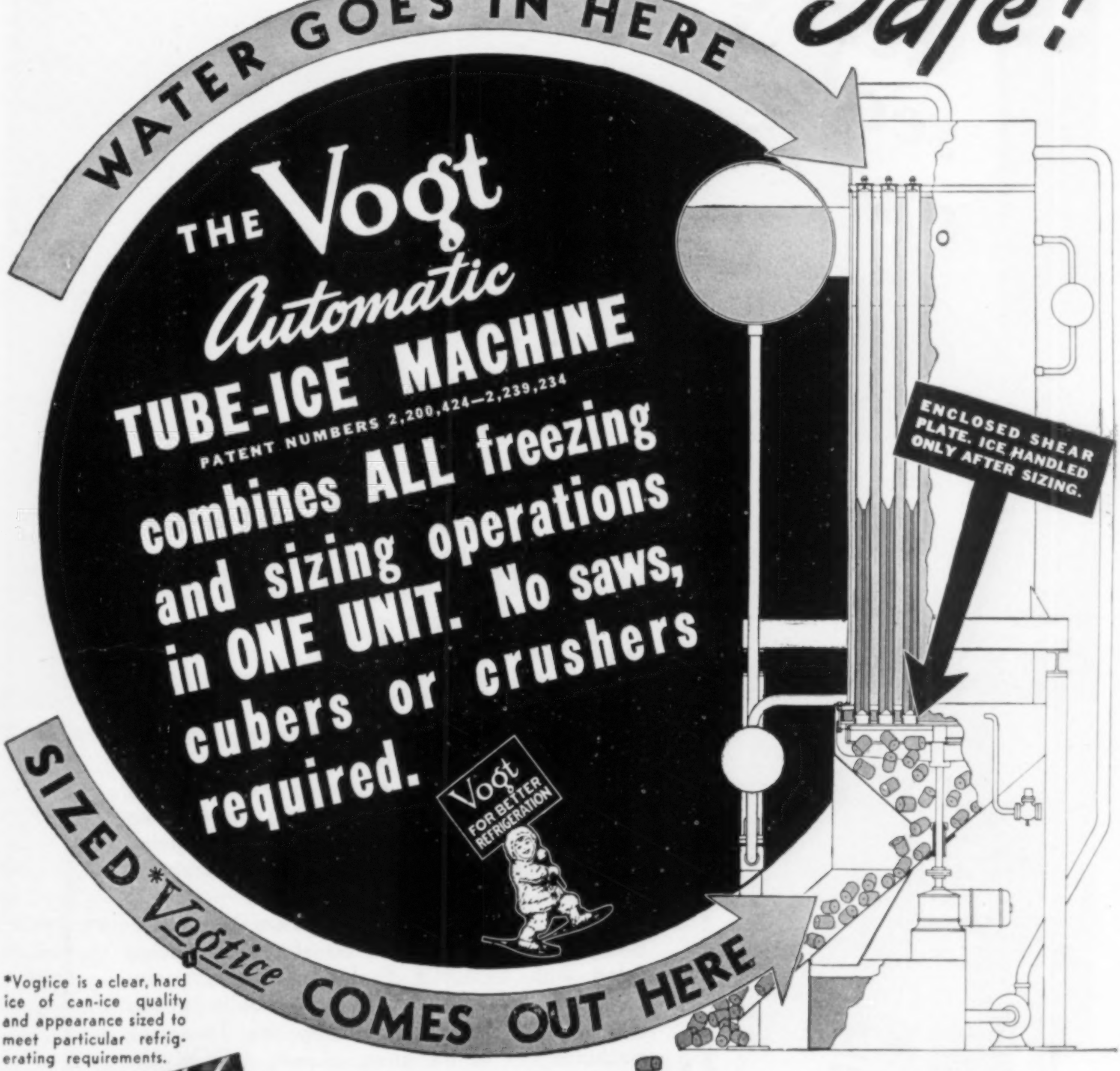
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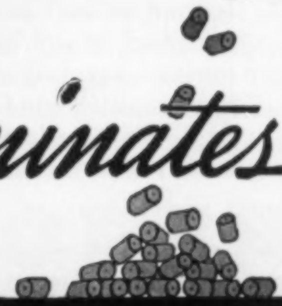

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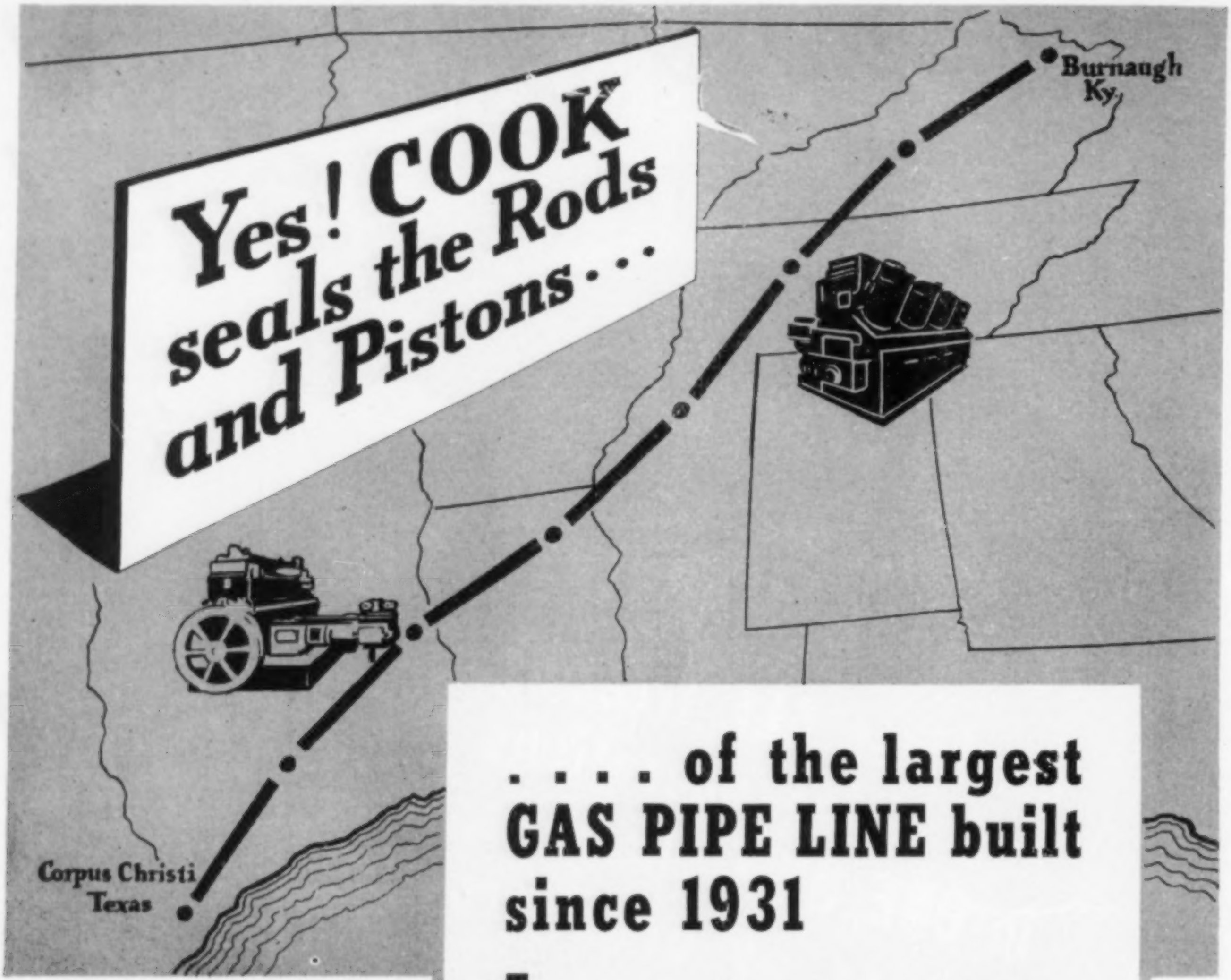
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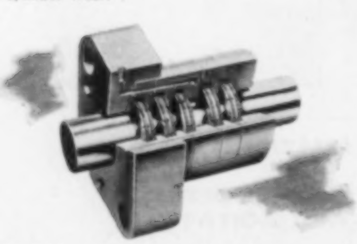

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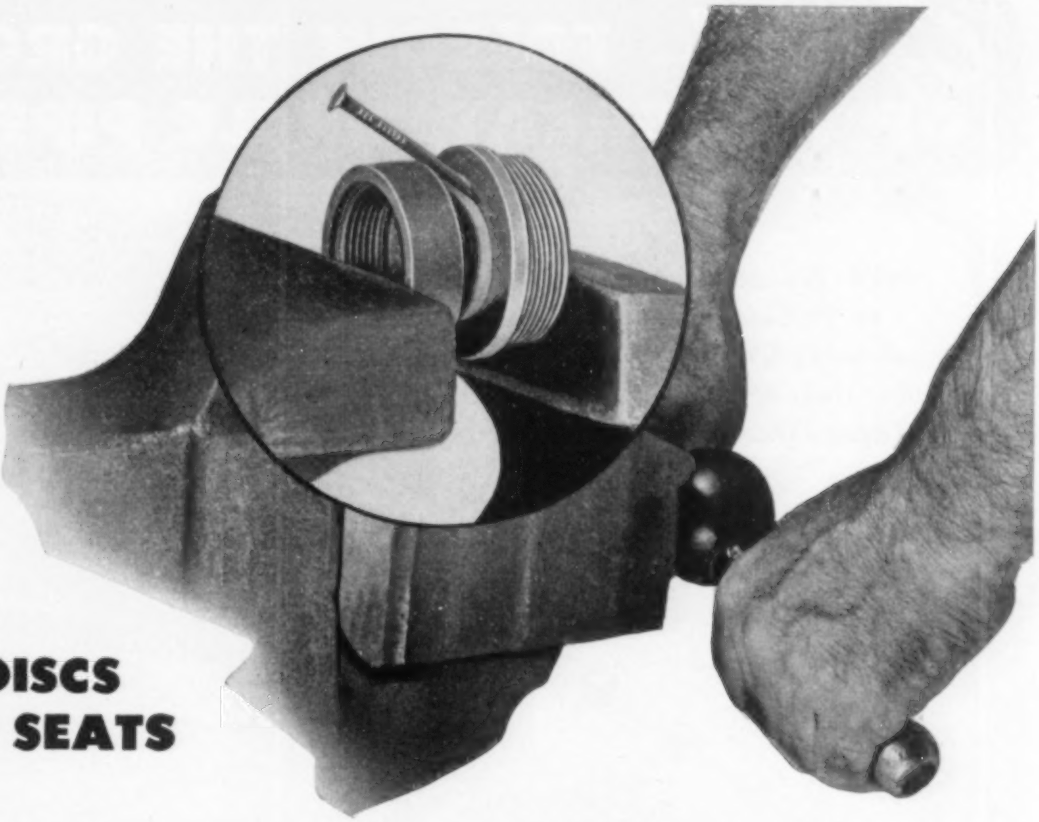

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THE Walworth No. 225P is the hardest . . . toughest Bronze Valve your money can buy. Its stainless steel seats and discs, heat treated to 500 Brinell (hard enough to crush nails) can be closed on boiler scale, sand, grit, and similar abrasive particles without marring the seating surfaces. "Wire drawing" is eliminated. Even after years of severe service it will assure tight, positive shut-off.

Further, every other part of Walworth No. 225P has been designed and constructed to afford full protection against wear and leakage. Available in both globe and angle types (angle type No. 227P) in sizes from 1/4" to 2", this quality valve is recommended for superheated steam up to 500 F, and 1000 pounds non-shock service on cold oil, water, gas or air.

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Nail flattened without marring either the valve seat or disc.

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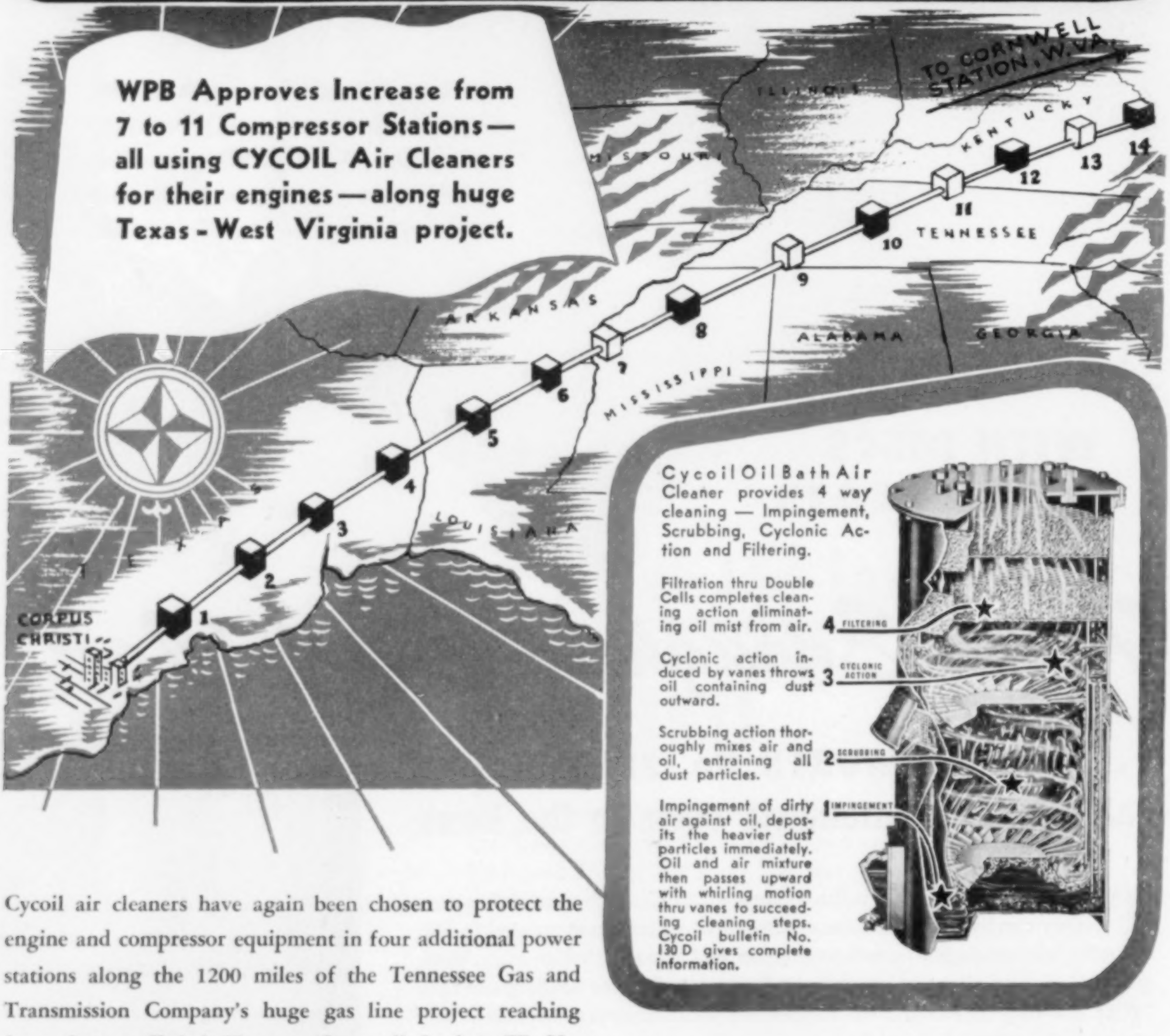
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1 IMPINGEMENT

WPB Approves Increase from 7 to 11 Compressor Stations—all using CYCOIL Air Cleaners for their engines—along huge Texas-West Virginia project.

Cycoil Oil Bath Air Cleaner provides 4 way cleaning — Impingement, Scrubbing, Cyclonic Action and Filtering.

Filtration thru Double Cells completes cleaning action eliminating oil mist from air.

Cyclonic action induced by vanes throws oil containing dust outward.

Scrubbing action thoroughly mixes air and oil, entraining all dust particles.

Impingement of dirty air against oil, deposits the heavier dust particles immediately. Oil and air mixture then passes upward with whirling motion thru vanes to succeeding cleaning steps. Cycoil bulletin No. 130 D gives complete information.

Cycoil air cleaners have again been chosen to protect the engine and compressor equipment in four additional power stations along the 1200 miles of the Tennessee Gas and Transmission Company's huge gas line project reaching from Corpus Christi, Tex., to Cornwell Station, W. Va. The seven initial compressor stations were Cycoil equipped when the pipe line was ready for use late last year. The additional stations recently authorized by the WPB raises the total to eleven leaving three yet to be installed. With a record of performance unequaled by any other type of engine and compressor filter, Cycoils were selected because of their high efficiency in dust removal, made possible by their exclusive 4-way air cleaning principle described above.

The Cycoil oil bath air cleaner is one of a complete line of air cleaners designed by AAF engineers for every engine and compressor service. Each filter in this line is available in a complete range of capacities. Write for descriptive bulletins.

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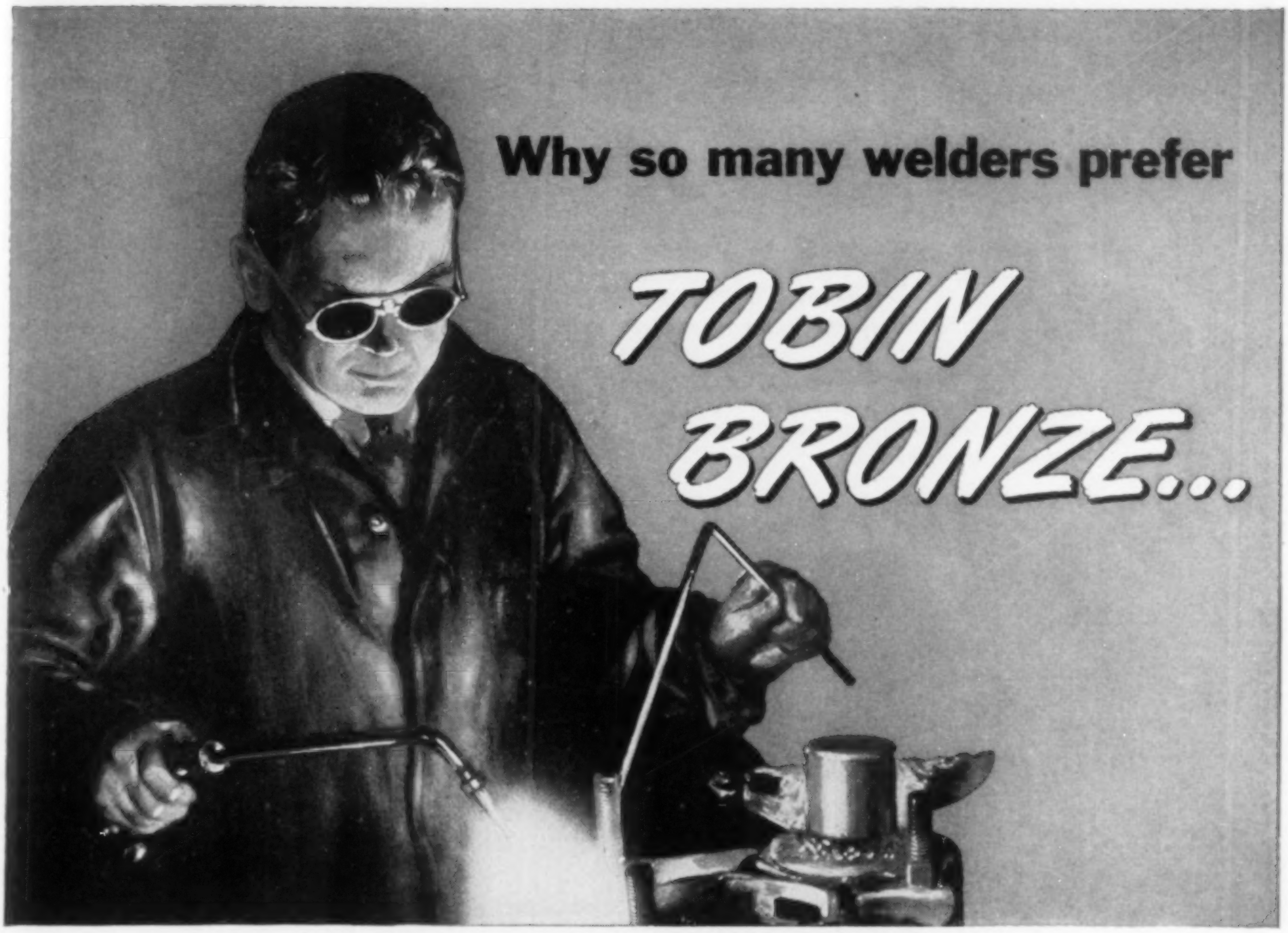
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FLOWS FREELY • UNIFORM COMPOSITION

FEW WELDING RODS combine all the advantages offered by Tobin Bronze*. That is why this general-purpose Anaconda Welding Rod is so widely used for repairs to cast and malleable iron, steel, copper, nickel and their alloys.

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For detailed information on Tobin Bronze and other Anaconda Welding Rods, write for Publication B-13, "Anaconda Welding Rods."

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- Maxim can show more years of research and experience in solving tough silencing problems.
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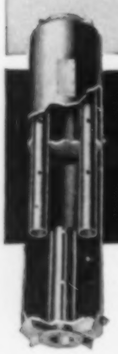
By the same token when special silencers *are* needed, Maxim engineers, constantly working on development and new design problems, are particularly capable of solving your special problems.



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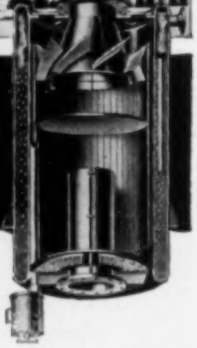
WH 101
WH 103



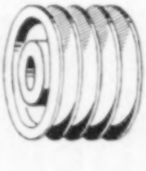
These Maxim Silencers (model MUC illustrated) are designed to silence the exhaust or intake of internal combustion engines, steam engine exhaust, air compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Wide choice of models to fit varying space and silencing requirements. Spark arresting where necessary.

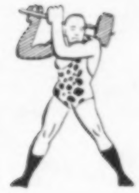
Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the efficient recovery of waste exhaust heat to produce steam or hot water for heating or processing operations. These Heat Recovery Silencers give highly efficient heat transfer . . . are available with automatic controls, and may be run wet or dry without injury to the unit.

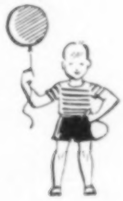
THE MAXIM SILENCER CO. • 85 HOMESTEAD AVE., HARTFORD, CONN.

ARMY E NAVY

MAXIM

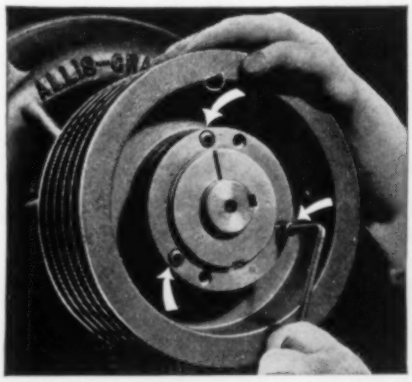
Changing ☛  was

a job for ☛  but

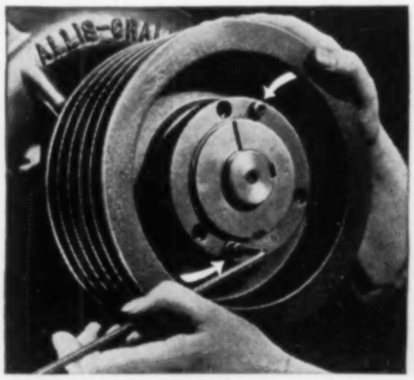
now ☛  could do it

No bulging muscles needed! Allis-Chalmers' new "Magic Grip" — *fastest mounting and demounting sheave on the market* — slides on and off *easily!*

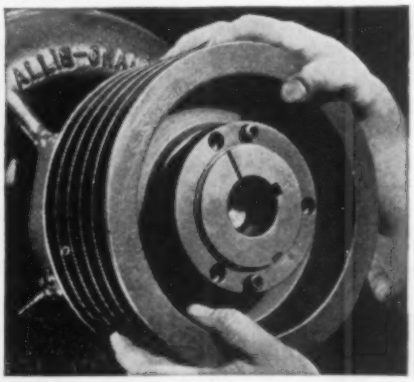
☛ SEE HOW QUICKLY AND EASILY THIS SHEAVE COMES OFF THE SHAFT



1 **Remove three capscrews** from bushing collar. A handy wrench — supplied with each sheave — is the only tool needed to remove Allis-Chalmers' new "Magic-Grip" from motor or machine shaft quickly and easily.



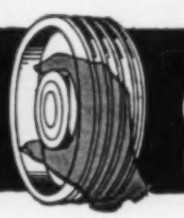
2 **Insert two capscrews** in tapped holes. As screws are turned, they become levers . . . automatically breaking tight grip of tapered split bushing on sheave and shaft. Entire unit is then ready for removal.



3 **Remove sheave from shaft.** Requires no mallet, no prying, no bulging muscles. You just slide the sheave off . . . smoothly, quickly. *It costs nothing extra!* Send for B6310. Allis-Chalmers, Milwaukee 1, Wis.

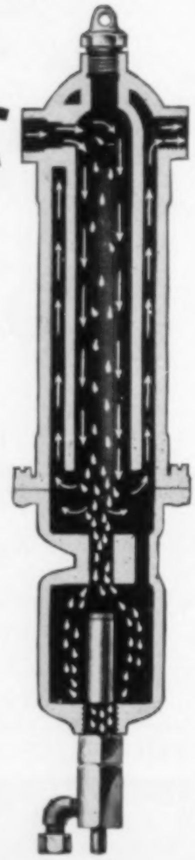
A 1856

Allis-Chalmers Texrope

"MAGIC-GRIP"  SHEAVES

There's no ? where the OIL and WATER go when you're using a SWENDEMAN SEPARATOR

Moisture-laden, oily compressed air goes in here



Clean, dry, oil-free air comes out here for maximum satisfaction in any use

Here is the one and only sure way to eliminate oil and moisture from your compressed air lines — by automatically and continuously ejecting them from the system. No trap, no intermittent blow-off device can give full efficiency. Some actually put moisture into the air as velocities increase.

In every class of work the Swendeman Air Separator can increase air-use efficiency, as it eliminates rust and ice formation, water hammer and product spoilage from air contamination

- Write for literature today.

Oil and water go out of the system here — and stay out!

Spraying paint, enamel, anti-rust solution

Spraying metal coatings

Spraying water: in laundries, humidifying

Sand blasting: cleaning castings, steel, carving monuments, removing paint

Cleaning machinery, cars, furs, motors and generators

Blowing glass, molds

Drying cars, grain, bottles

Operating punch presses, machines, drills, hammers, grinders, chucks, valves, etc.

Running pneumatic hoists, lifts

Switch and signal systems

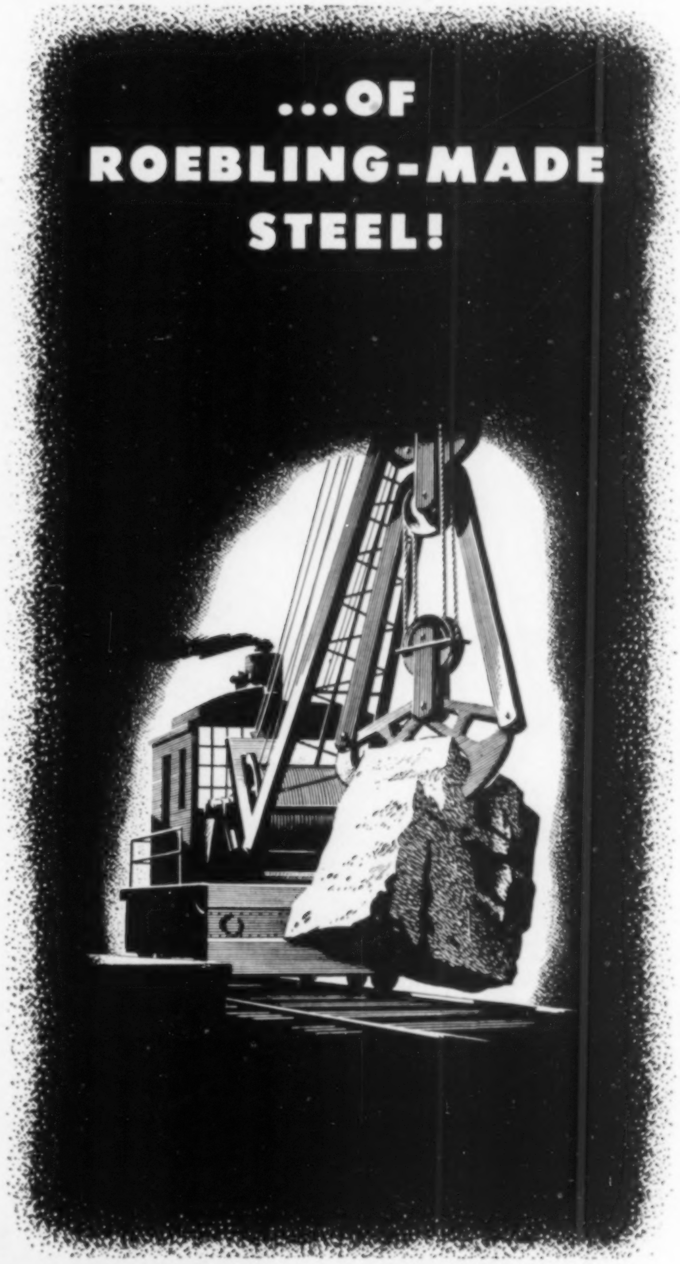
Furnaces

A-4

SWENDEMAN
Automatic Air Separator
A DEXTER PRODUCT

***The* LEAVITT**
MACHINE COMPANY
ORANGE, MASSACHUSETTS

Wire Rope Value Begins With Wire



...OF ROEBLING-MADE STEEL!

WHAT DETERMINES THE PERFORMANCE you get from wire rope? It's the handling it gets—the equipment it works on—the job to be done.

All these count. But what counts *most* is the rope itself. And that's the reason why you should rig your shovels, cranes and draglines with Roebling "Blue Center" Wire Rope.

For "Blue Center" gives you dependable performance—even under severe and abusive conditions. It's rope quality that begins with wires drawn from finest steel . . . Roebling-made!

To get *best* results from "Blue Center" select the right rope . . . and use it right. Roebling engineers will be glad to show you how. Call or write our nearest branch office.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

WIRE ROPE AND STRAND • FITTINGS • SLINGS AERIAL WIRE ROPE SYSTEMS • SUSPENSION BRIDGES AND CABLES • COLD ROLLED STRIP • HIGH AND LOW CARBON ACID AND BASIC OPEN HEARTH STEELS • ROUND AND SHAPED WIRE • ELECTRICAL WIRES AND CABLES • WIRE CLOTH AND NETTING • AIRCORD, SWAGED TERMINALS AND ASSEMBLIES

ROEBLING
WIRE ROPE
TRENTON N.J.

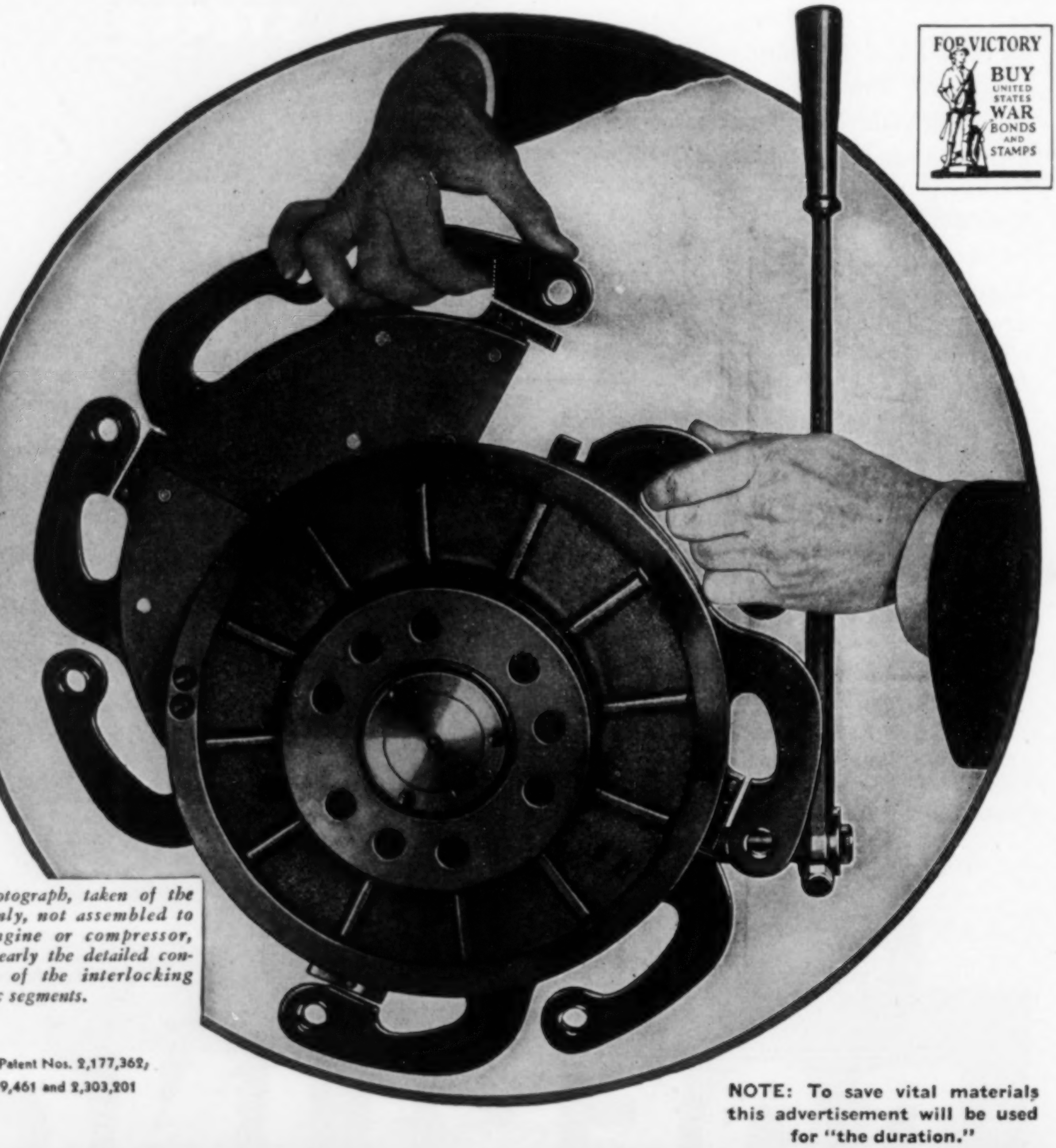
ROEBLING

PACEMAKER IN WIRE PRODUCTS

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.

FOR VICTORY
BUY
UNITED STATES
WAR
BONDS
AND
STAMPS



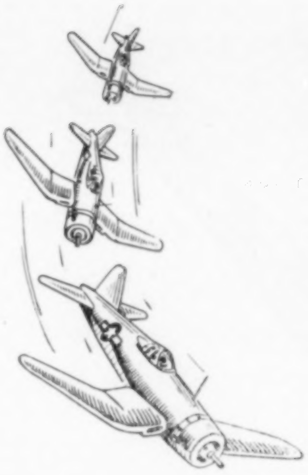
This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

U. S. Patent Nos. 2,177,362; 2,259,461 and 2,303,201

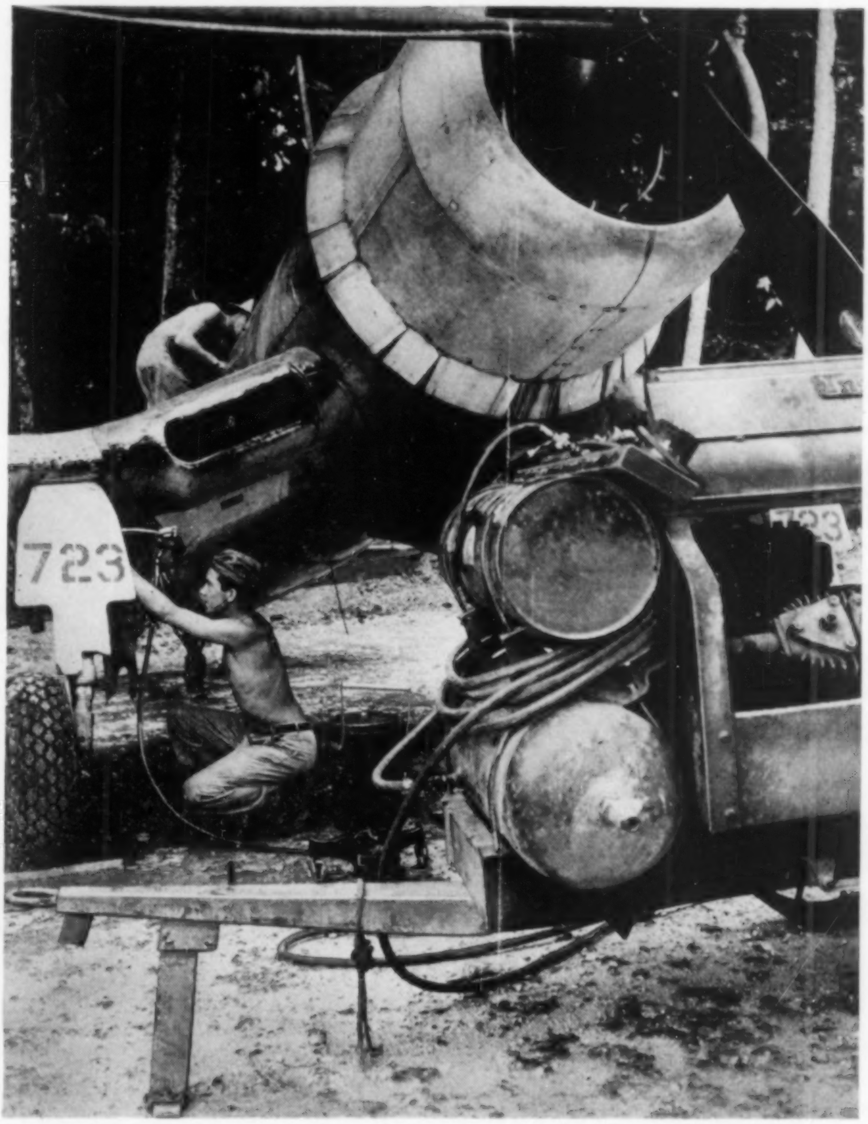
NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha — Wisconsin



COMPRESSED AIR *helps keep* CORSAIRS IN THE AIR



Official Marine Corps Photo

A large share of the credit for Marine successes in the Pacific goes to the ground crews at island bases. Safety of the pilot, the performance of the plane, and the success of each mission depends upon the skill and diligence of mechanics who daily service the aircraft.

Every part must be double-checked, lubrication must be thorough and complete, tires inflated, damaged planes must be patched up, and their motors overhauled or replaced, so that every available unit can be put back into the fight.

Here at an airfield at Bougainville we see them servicing a Corsair fighter with the aid of compressed air furnished by an Ingersoll-Rand D-85 MOBIL-AIR compressor. Their tasks are made much easier and done quicker by the use of Compressed Air. It is the *only* way many jobs can be done.

You will find MOBIL-AIR compressors and Ingersoll-Rand Air Tools serving the Armed Forces of the United Nations all over the world.

D-85 MOBIL-AIR, one of 7 sizes with capacities from 60 to 500 cfm.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

2-499

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

A Study in EFFICIENCY

The speed and smoothness with which a Bucyrus-Monighan walking dragline executes its digging cycle . . . the effortless way its rolling-cam walking action carries the unit safely around trouble . . . the easy control and split-second response . . . the almost unbelievably low maintenance requirements of the simple machinery — every aspect of Bucyrus-Monighan performance is a study in the efficiency that means low-cost stripping. "Years Ahead" in every respect, today's Bucyrus-Monighans are the outgrowth of a unique combination of engineering skill, experience, research, and manufacturing facilities. The same combination is continually at work to develop even more effective walking draglines for your work of tomorrow.

4M45

BUCYRUS MONIGHAN

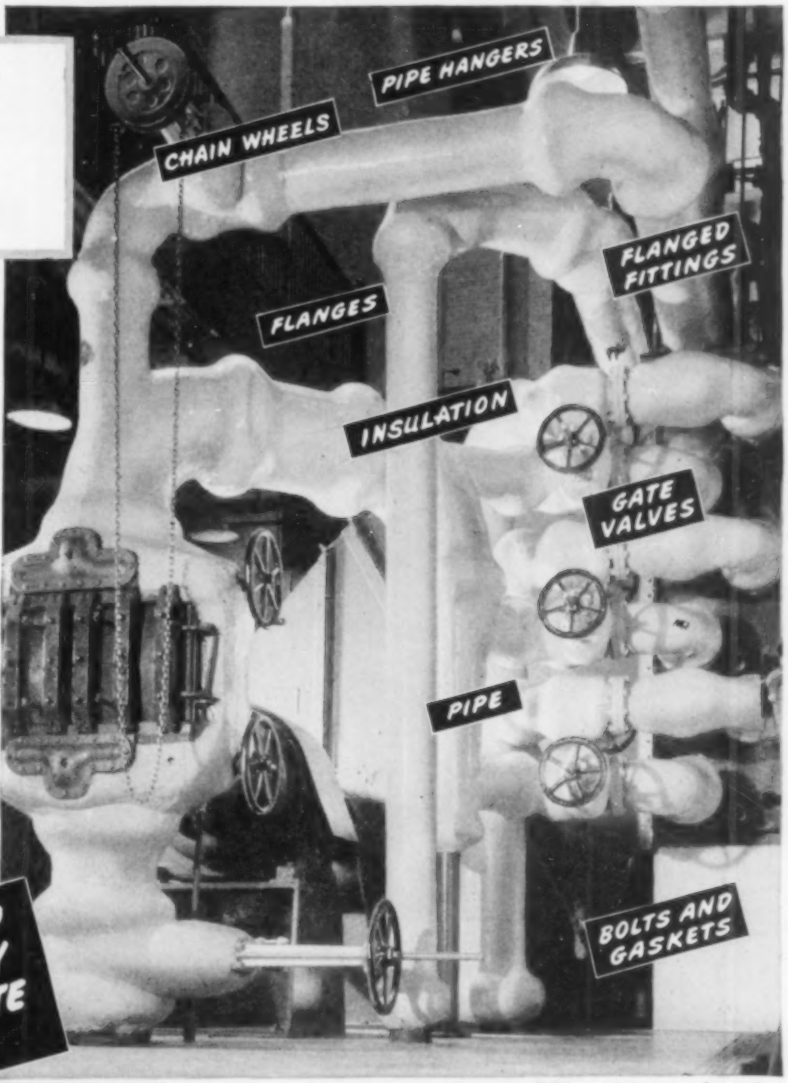
sold by **BUCYRUS-ERIE COMPANY**

SOUTH MILWAUKEE, WISCONSIN

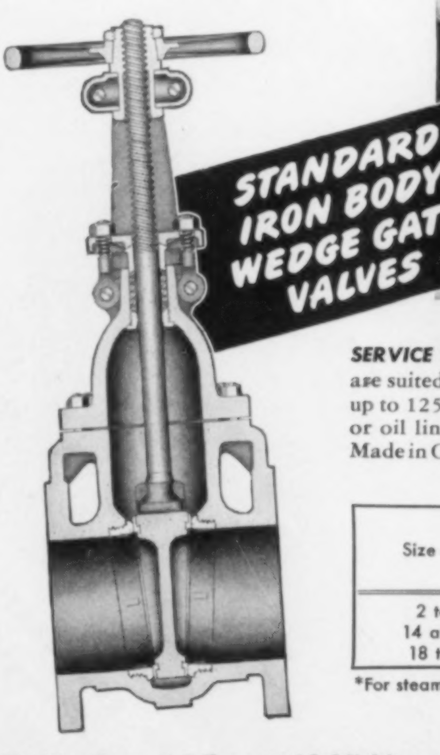
How the Complete CRANE Line Simplifies Piping Replacement Work

ONE SOURCE OF SUPPLY
ONE RESPONSIBILITY
ONE STANDARD OF QUALITY

The unusual completeness of the Crane line is of distinct advantage in "converting" piping systems. See the service recommendations below for Standard Iron Body Gate Valves. Here's a typical Crane solution to many deferred valve replacements. Your Crane Branch or Wholesaler supplies all your piping requirements from the world's greatest selection in brass, iron, and steel equipment. One standard of quality in all materials and one responsibility for them help insure the best installations. Crane Co.'s 90-year manufacturing experience insures long-lasting dependability.



Water piping to air coolers



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** are suited for many services in factories and power plants, at all working pressures up to 125 pounds steam. Brass trimmed valves are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S.&Y. and Non-Rising Stem patterns. See page 101 of your Crane Catalog.

Working Pressures

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2-in., use Crane Clamp Gate Valves.)

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE **VALVES • FITTINGS • PIPE**
PLUMBING • HEATING • PUMPS

EXCELLENCE OF THE PRODUCT
REFLECTS EXCELLENCE OF THE PROCESS

MADISON-KIPP
DIE CASTINGS

The Die Casting process offers the product designer almost unlimited opportunities to add pleasing appearance, light weight and improved strength at an over-all cost saving.

In this advertising we illustrate the effective use of die castings in the new Madison-Kipp Model JA Air Grinder.

KIPP
Featherweight
AIR GRINDER

The Model JA is a new design both inside and outside. In it are utilized fewer parts, and they are made of Magnesium and Aluminum for extreme featherweight lightness. The speed, as before, is governed at 50,000 R.P.M. The same low price, $29.75 in the U. S. A. remains.

Weight 12 ounces; Length 6¾ inches; Chuck size ⅛ inch. Wheel guard removed for better illustration.

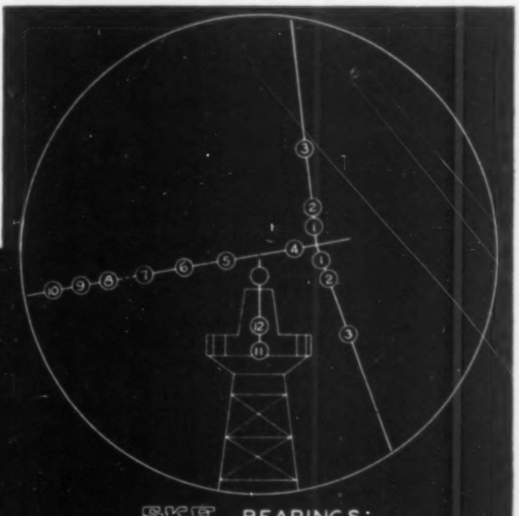
WEIGHT 12 OUNCES; LENGTH 6-3/4 INCHES; CHUCK SIZE 1/8 INCH.
WHEEL GUARD REMOVED FOR BETTER ILLUSTRATION.

MADISON-KIPP CORPORATION
202 Waubesa Street
Madison 4, Wis.
Sole Agent in England
Wm. Coulthard

HARNESSING the wind

to light 2,000 homes

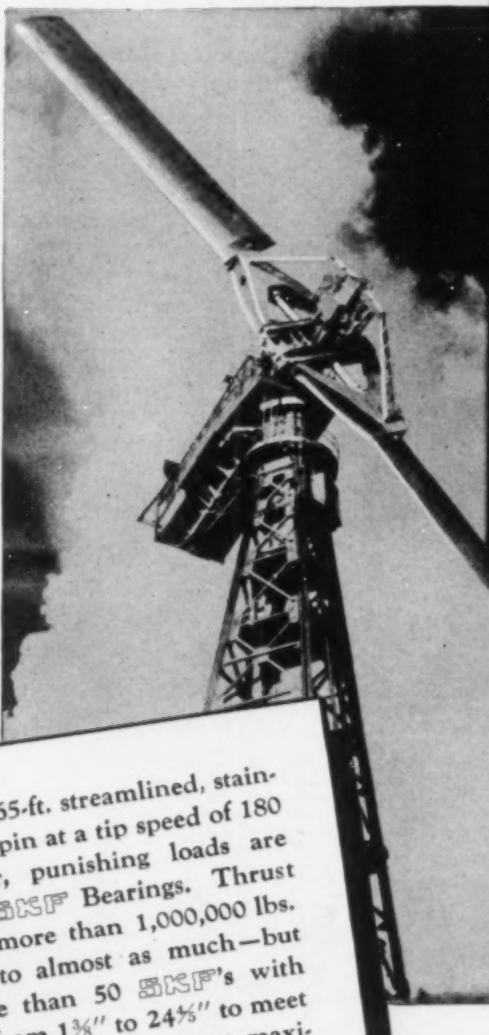
WITH SKF REDUCING FRICTION TO A VANISHING POINT



SKF BEARINGS

LOCATION	BEARING TYPE	BEARING DIMENSIONS BORE	O. D.	WIDTH
① BLADE	SPHER. ROLLER THRUST	14.500"	24.000"	6.750"
② BLADE	SPHERICAL ROLLER	11.8110"	19.6850"	6.2992"
③ BLADE	SPHERICAL ROLLER	20.8661"	34.2520"	10.7087"
④ TURBINE SHAFT	SPHERICAL ROLLER	24.8031"	40.5512"	12.4016"
⑤ TURBINE SHAFT	SPHERICAL ROLLER	18.1102"	32.6772"	11.6535"
⑥ INPUT GEAR SHAFT	SPHERICAL ROLLER	14.1732"	21.2598"	5.2756"
⑦ INPUT GEAR SHAFT	SPHERICAL ROLLER	10.2362"	15.7480"	4.0945"
⑧ OUTPUT PINION SHAFT	SPHERICAL ROLLER	6.6929"	12.2047"	3.3858"
⑨ OUTPUT PINION SHAFT	SPHERICAL ROLLER	6.6929"	12.2047"	3.3858"
⑩ CLUTCH	SINGLE ROW BALL	6.2992"	11.4173"	1.8898"
⑪ PINTLE	SPHERICAL ROLLER	11.8110"	19.6850"	6.2992"
⑫ PINTLE	SPHER. ROLLER THRUST	14.500"	24.000"	6.750"

- *Built under the financial sponsorship of S. Morgan Smith Co. to the designs of Palmer Coslett Putnam, Boston engineer and inventor, this Smith-Putnam Wind Turbine, world's largest windmill perched on top a 110-ft. steel tower on 2,000 ft. Grandpa's Knob, Vt., is designed to feed 1,000 kw. into the power lines of the Central Vermont Public Service Corp. — enough electricity to light five 100-watt lamps for each of 2,000 families.*



- *The SKF Spherical Roller Thrust Bearing (see No. 1 in diagram) absorbs a maximum thrust load of 1,039,390 lbs.*

When these two 65-ft. streamlined, stainless steel blades spin at a tip speed of 180 miles per hour, punishing loads are imposed upon SKF Bearings. Thrust loads climb to more than 1,000,000 lbs. —radial loads to almost as much—but there are more than 50 SKF's with bores ranging from 1⅜" to 24⅘" to meet them. For bearings that convert maximum *wind* power into *paying* power . . . that provide an equalized load distribution insuring full bearing capacity and long life, men who do things never done before invariably use SKF's.

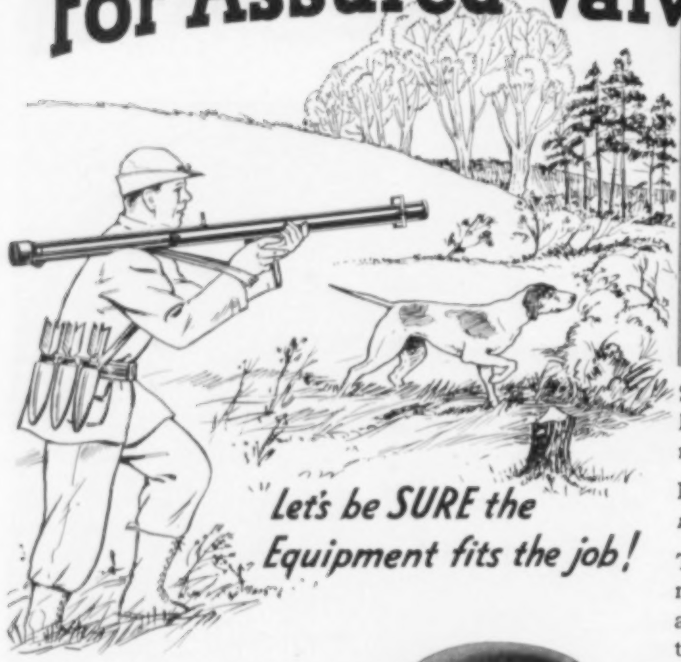
5816

SKF INDUSTRIES INC., PHILA. 34, PA.

SKF

BALL AND ROLLER BEARINGS

For Assured Valve Performance



Consult
POWELL ENGINEERING
First

Shooting quail with a bazooka would be nonsensical. But trying to make a valve do a job for which it is not suited doesn't make much sense, either.

For assured performance in flow control the valve *must fit the job.*

That's why Powell maintains a staff of valve engineers who are always at your service for consultation and advice. And if you have any individual flow control problems, Powell Engineering is ready to design the correct valves to meet them.

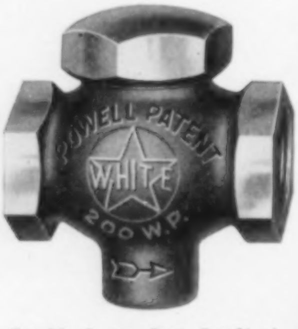


Fig. 95—Bronze Dash Pot Check Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed cap, and regrindable, renewable wear-resisting bronze disc. Because of the cushioning effect of the plunger in the dash pot, the seating of the disc is practically noiseless.

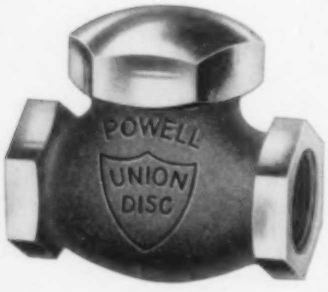


Fig. 158—Bronze Horizontal Lift Check Valve for 150 pounds W.S.P. Screwed ends, screwed cap and renewable vulcanized composition disc.

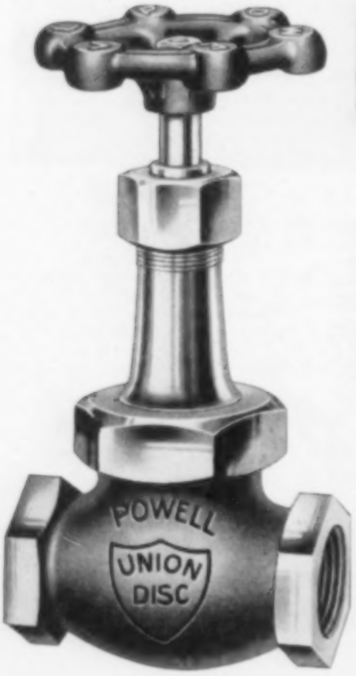


Fig. 150—Bronze Globe Valve for 150 pounds W.S.P. Screwed ends, union bonnet and renewable vulcanized composition disc.

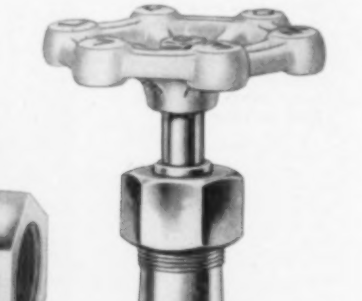


Fig. 1708—Bronze Globe Valve for 200 pounds W.S.P. Screwed ends, union bonnet, renewable seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze semi-cone, plug type disc.

The Wm. Powell Co.

Dependable Valves Since 1846

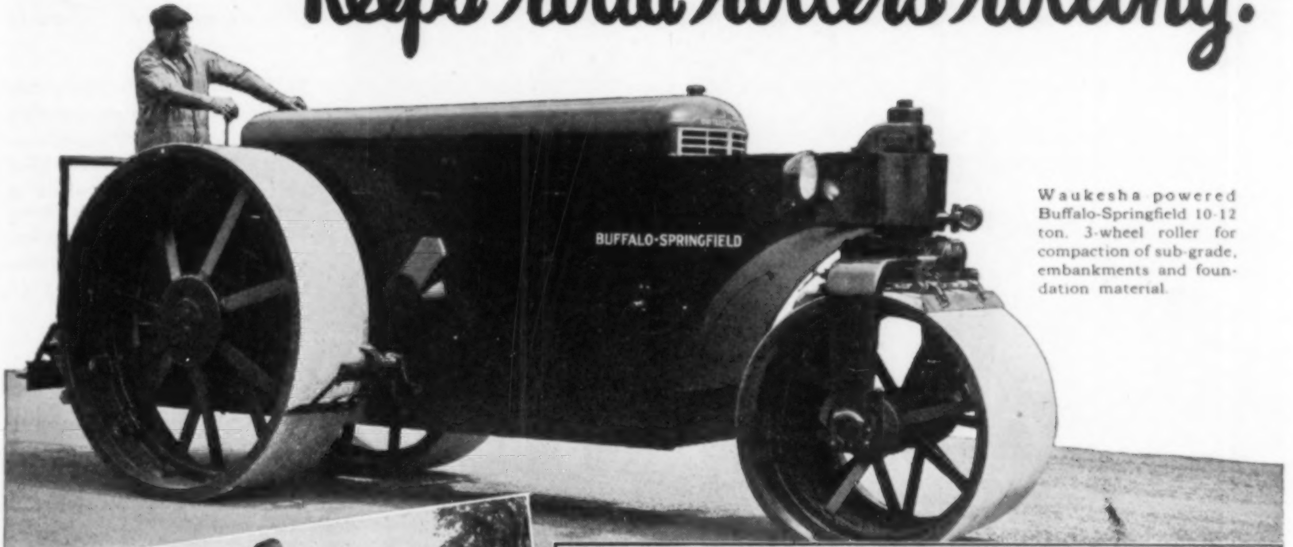
Cincinnati 22, Ohio

DISTRIBUTORS IN PRINCIPAL CITIES

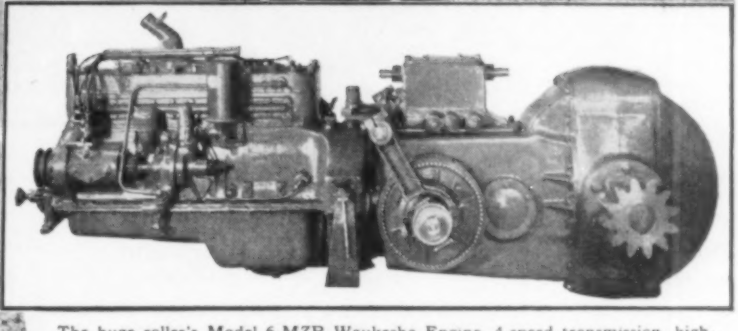
POWELL VALVES

WAUKESHA POWER

keeps road rollers rolling!



Waukesha powered Buffalo-Springfield 10-12 ton. 3-wheel roller for compaction of sub-grade, embankments and foundation material.



The huge roller's Model 6-MZR Waukesha Engine, 4-speed transmission, high-speed clutches, and final drive components are a solid one-piece assembly

A Model FC Waukesha Engine powers this Buffalo-Springfield trench roller which is used for either trench rolling or road widening. Some states already *require* the use of this machine on all road widening projects.

- Power plus speed—that's what Waukesha Engines put into Buffalo-Springfield rollers whether they're big 10-12 ton three-wheelers or trench rollers.

Made by The Buffalo-Springfield Roller Co., Springfield, Ohio—the largest exclusive producers of rollers in the world—they're known everywhere for *smoother rolling*.

Just as Waukesha Engines—built by the world's largest builders of heavy-duty internal combustion engines—are equally famous for *smoother running*.

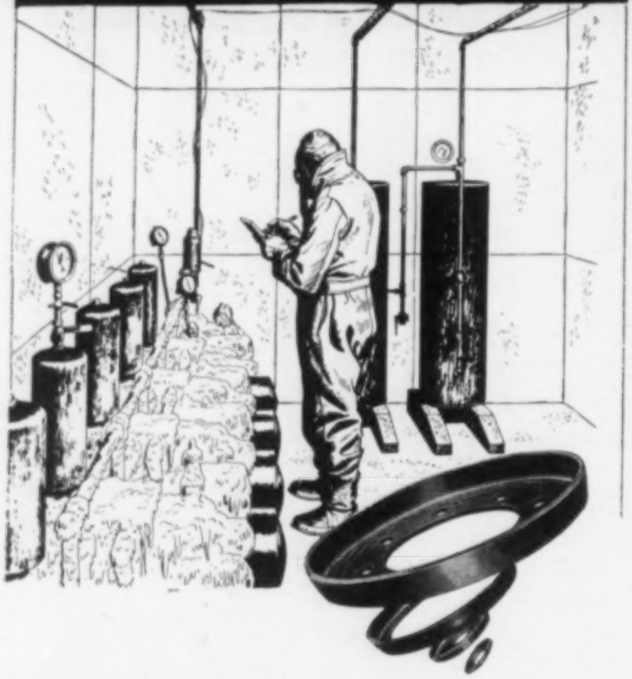
Now every Waukesha is a war-work engine. For your future engine needs—to power shovels, cranes, hoists, pavers, mixers, graders, portable compressors, pumps, welders, rock crushers, screening plants, etc., consult Waukesha now. Get Bulletin 1079.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
NEW YORK • TULSA • LOS ANGELES

MORE POWER FOR VICTORY

WAUKESHA ENGINES

This "*Arctic Exploration*" discovered better piston packing cups



A transplanted polar region played an important part in the development of Wabco piston packing cups for pneumatic and hydraulic cylinders.

In this cold room, so frigid that workers dress like stratosphere fliers, Wabco packing demonstrated its ability to retain resilience, mechanical strength, and sealing properties under extremes of temperature far greater than are ever expected in actual industrial service.

In addition to their staying powers, Wabco packing cups offer an important mechanical feature. The built-in limited compression feature, available in 1-inch to 7½-inch sizes, assures low friction of the packing against the cylinder wall.

Wabco packing cups for original installation in hydraulic and pneumatic cylinders are available in 363 sizes, ranging from ¾-inch to 30-inch.

Westinghouse Air Brake Co.
Industrial Division - - - Wilmerding, Pa.

"OIL KING" AIR HOSE

For Hard, Heavy Service on All Pneumatic Tools

STYLE D-137. A heavy-duty hose that will stand up under the roughest handling. Wrapped construction, Synplastic tube, black cover. Recommended where an excessive amount of oil is present in the tube. Smaller sizes particularly suitable for portable compressor work. Sizes: ½" to 1¼", inclusive.

Contact Our Nearest Branch or Main Office for Details

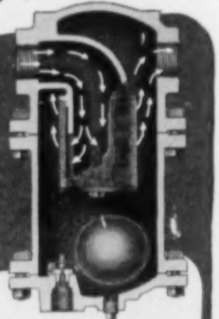
GOODALL
RUBBER COMPANY INCORPORATED

The Goodall-Whitehead Companies
Philadelphia. Trenton. New York. Chicago.
Pittsburgh. Boston.

GOODALL RUBBER CO. of CALIF. GOODALL RUBBER CO. of TEXAS
Factory - Trenton, N. J. Established 1870

SELF DRAINING

Today's newest idea in SEPARATOR DESIGN . . .



● With this new Johnson Type "SA" Separator there's no need for external traps—no more bother and uncertainty of manual draining. It has a complete trap mechanism built right in—drains itself automatically whenever necessary.

Like all Johnson Separators it removes more than 99% of all moisture and dirt from compressed air or steam. It can be teamed up with the Johnson Aftercooler where moisture has been vaporized by heat of compression, or with the Johnson Oil Absorber where every trace of oil must be removed.

Johnson Separation Devices come in sizes, styles for all needs. Write for new bulletin.

THE Johnson Corporation
830 WOOD STREET, THREE RIVERS, MICHIGAN

ATLAS STEEL CASTING COMPANY

OPEN HEARTH & ELECTRIC STEEL
1963 ELMWOOD AVENUE
BUFFALO, N. Y.

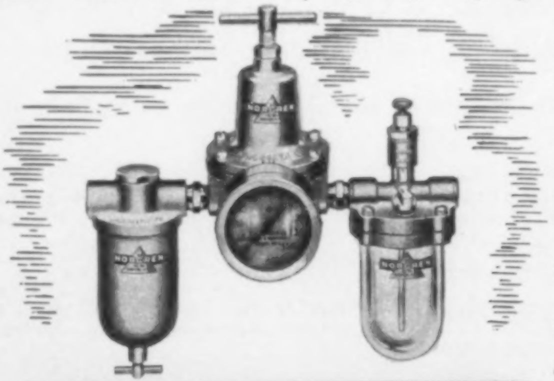
NEW YORK OFFICE
60 East 42nd Street

MAIN OFFICE
AND WORKS
BUFFALO, N. Y.

C. R. WYCKOFF
President and Treasurer
E. L. ALTENBURG
Vice-Pres. and Gen. Mgr.

★

L. G. SULLIVAN
Vice-President
A. J. WESTPHAL
Secretary and Mgr. of Sales

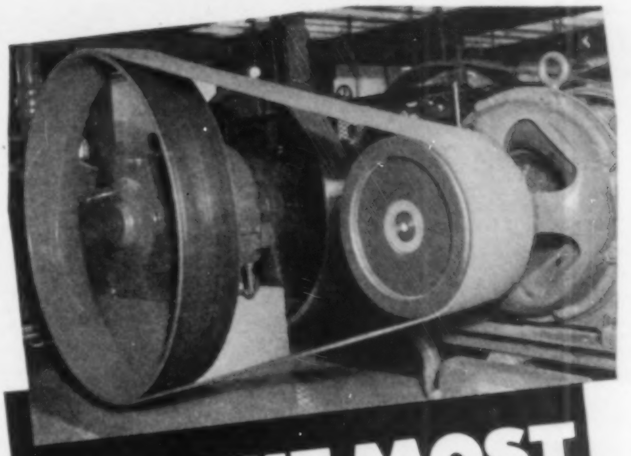


DEPENDABLE PROTECTION

Get positive, dependable protection for all your air driven tools and cylinders. Install a Norgren Lubro-Control Unit in your air lines. An assembly of filter, regulator and lubricator; cleans, controls and lubricates the air for smooth, power-packed air tool performance. *Maximum production with minimum maintenance.*

Investigate today. Write C. A. Norgren Co., 220 Santa Fe Drive, Denver 9, Colorado.

Norgren



GET THE MOST OUT OF YOUR COMPRESSOR

-with short center

SCHIEREN LEATHER BELTING

ON A PIVOTED MOTOR BASE

With SCHIEREN LEATHER BELTING to assure stronger grip over a longer life of service combined with the automatic, constant, correct tension of a pivoted motor base, you'll get the absolute utmost out of your air compressor. SCHIEREN LEATHER means minimum maintenance even in bad oil conditions — shutdowns minimized to an extreme rarity — and continuous maximum efficiency at peak loads . . . For SCHIEREN LEATHER BELTING hasn't been surpassed in 75 years! Write us for full information and our estimate on your next drive — without incurring obligation of any kind.

SCHIEREN QUALITY LEATHER PACKINGS
for every usual and unusual requirement give you lower annual packing cost and higher production efficiency.
Send for catalog.

National Distributors of Rockwood Bases

CHAS. A. SCHIEREN CO.
LEATHER BELTINGS • SPECIALTIES
HYDRAULIC PACKINGS
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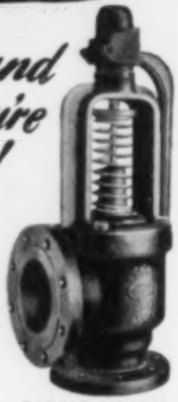
60 FRONT STREET, WEST, TORONTO, ONTARIO

Specify
**FARRIS
SAFETY
VALVES**
...and you're safe!



FARRIS VENTURI TYPE SAFETY VALVE, Type 2150. Steam separator. Meets ASME requirements. In steel for 600 lb.; iron 250 lb. Sizes ¾" to 6". Oversize outlets for rapid exhaust.

Here is the FARRIS Venturi Type Safety Valve No. 2150. High-lift disc action for high-capacity discharge on high-pressure, high-temperature jobs. Advanced design, quality materials, precision machining of every finished surface—for your safety! And dependable precision operation assures minimum blowdown for economical plant operation. Built for long-life service without maintenance expense.

Just one of the complete line of FARRIS Safety, Pop and Relief Valves. Write today for Bulletin.

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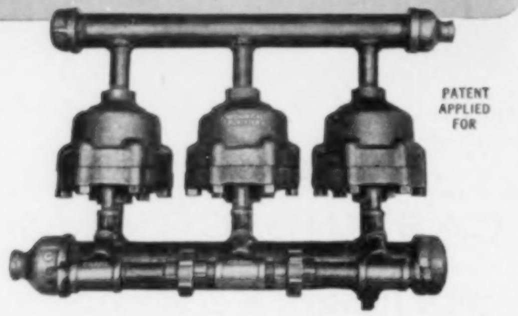
354 Commercial Ave., Palisades Park, N. J.

Farris
SAFETY and RELIEF VALVES

Purify Any Pressures, Air or Gas, with Bird-White Multiple Unit *Pur-O-fier*



Three Models Available

Model A-1 furnished with a 1 inch turbo-rotor and will accommodate volumes from 1 to 8 cubic feet.

Model A-2 has a 2 inch turbo-rotor and can accommodate volumes from 10 to 35 cubic feet.

Model A-4 has a 4 inch turbo-rotor and can accommodate volumes from 35 to 100 cubic feet.

Bird-White multiple unit Pur-O-fiers save time and money by protecting air-operated machines, gauges and controls from contamination. They give positive purification to air or gas lines regardless of fluctuating pressures or high volumes.

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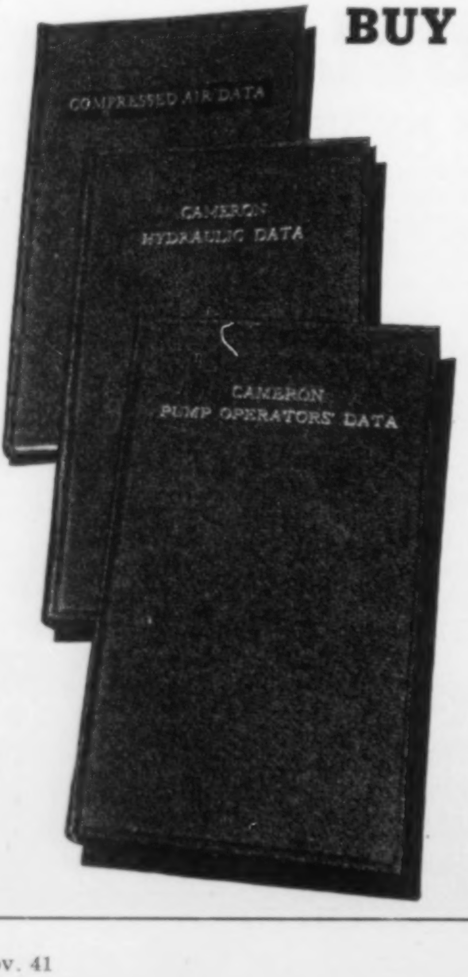

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for faster drilling

Here's a sure, safe tonic for a listless drilling record: Bethlehem hollow drill steel.

For years, under its trade name Bethlehem Superior, it's been a favorite of both drill runners and blacksmiths. Reasons vary, but one of the commonest is, "Bethlehem Superior is easier to work with and doesn't need dressing as often."

The following features tell you why:

- ★ The steel is always true to size and makes up readily.
- ★ It is easy to heat-treat because it has a wide quenching range. This, in turn, results in better hardness.
- ★ It gives a shank that withstands the heavy battering of the drill piston.
- ★ The hole is smooth, true, and well centered. This means better fatigue-resistance, longer life.

Bethlehem Superior is a dual-purpose steel. Whether you thread it for detachable bits or forge on your own bits, it will respond equally well. Ask for it by name the next time you order drill steel.

REALLY TURNIN' 'EM OUT, EH, BILL?
HAVEN'T I BEEN TELLIN' YOU, CAP? THIS BETHLEHEM SUPERIOR MAKES UP FASTER AND EASIER.

BETHLEHEM SUPERIOR HOLLOW DRILL STEEL

★ BETHLEHEM STEEL ★

James Watt (1736-1819) perfected Newcomen's steam engine and adapted it to drive machinery of all kinds. Illustration from Bettmann Archive.

JAMES WATT
Perfected the Steam Engine in 1781

"One Sunday morning" wrote James Watt, "the idea occurred to me that steam would expand and rush into a vacuum." At that moment the modern steam engine was born in Watt's brain—a flash of genius for which all mankind is thankful.

About the time steam engines came into general use nearly a century later, Garlock began manufacturing packings to improve their operation—and today Garlock supplies packings and gaskets for millions of engines now in use throughout the world.

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CHEVRON PACKING is one of the many Garlock quality-controlled packings. The unique hinge-like design allows the packing to expand and contract—it adjusts itself automatically to variations in pressure.

Garlock

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SNUB THE SLUG
PREVENT THE NOISE
BURGESS SNUBBERS
for
Quiet Compressor Intakes
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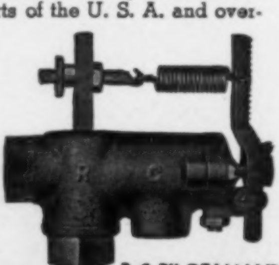
R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



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PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

FOR AIR COMPRESSORS

class 9213AH3

PRESSURE SWITCH

200 lbs. pressure limit
15 to 40 lbs. differential

● A two-pole device for intermediate-sized motors. Simply-designed, huskily-built mechanism delivers long life and trouble-free operation with a minimum of servicing.

Quickly wired. Range and differential easily adjusted in the field. Offered with or without pressure-release valve for easier motor starting.

Write for Catalog • photos, specifications of Square D pressure switches and related devices. Address Square D Regulator Division, 6060 Rivard Street, Detroit 11, Michigan.

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WHAT USERS SAY: "*Bearium Metal* has not cut out under . . . granite dust . . . as had babbitt; neither has the shaft cut or worn."

" . . . *Bearium* proved to be such a tremendous improvement over other metals that we have authorized its use for all outside machinery throughout our fleet." (20 trawlers)

"*Bearium Metal* in our gear-cutting machine has disclosed no appreciable wear after having operated continuously . . . carrying a load of 54 tons."

BEARIUM METAL
★ Does not seize shaft ★ Prevents bearing failures
★ Will not score ★ Increases bearing life

BEARIUM METALS CORP.
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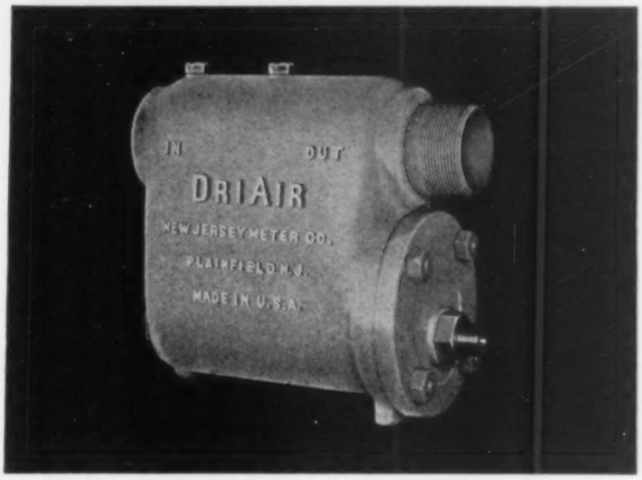
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

● The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

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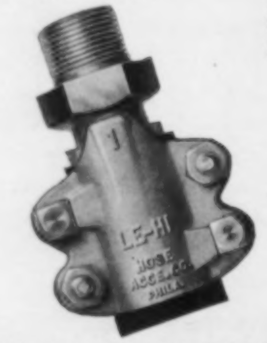
PLAINFIELD, NEW JERSEY

There's
NO PRESSURE DROP
on
HIGH PRESSURE LINES
when
LE-HI HOSE COUPLINGS
ARE CARRYING
THE LOAD

LE-HI Series 100 Universal Type Hose Couplings. Applicable for compressed air and many special uses where a quick detachable coupling is desirable.

LE-HI Series 400-W and G Female Washer or Ground Joint Type Coupling with I.P.T. Spud. Sizes 3/4" and smaller furnished with two-bolt clamp and 1" and larger with four-bolt clamp.



LE-HI Series 500 Male Hose Coupling, companion unit for LE-HI Series 400-G and 400-W. It is completely adaptable to the widely diversified applications where the female units are used.

Ever stop to think how much it costs you every time your compressor runs full time . . . without cutting in and out?

Compressors and other primary equipment have to work "overtime" too often because of leaks caused by faulty hose couplings and fittings. Guard against pressure drop and loss of expensive power by using LE-HI Hose Couplings on your hose lines. Put the wear and tear on LE-HI . . . not on the equipment that costs thousands of dollars.

For example, on air compressors, pile driving equipment, road pumps, jetting pumps, and other hydraulic equipment, or for conveying air or steam under high pressure, specify LE-HI Series 400 and 500 Hose Couplings. Powerful clamps grip the coupling securely to the hose so that it will not leak or blow off.

Avoid pressure losses and costly shut downs. Specify LE-HI . . . a diversified line of hose couplings for industrial and construction use.

Sold Only
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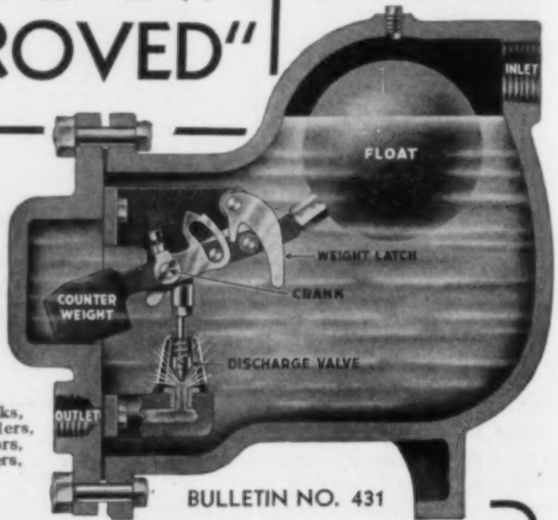
HOSE ACCESSORIES CO.
2716 North 17th Street, Phila. 32, Pa.

LE-HI
HIGH and LOW PRESSURE
HOSE COUPLINGS

"PLANT PROVED"

Nicholson Model "JR" Compressed Air Trap



For
Air Tanks,
Aftercoolers,
Separators,
Receivers,
Etc.

BULLETIN NO. 431

America's Fastest Acting
COMPRESSED AIR TRAP

Due to their exclusive weight-operated design, Nicholson Model "JR" Compressed Air Traps open and close instantaneously, giving full faster drainage of water and oil. Plant-proved for most air applications.

W. H. **NICHOLSON** & CO.
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Valves • Traps • Steam Specialties

ROD BABBITTING
ANOTHER PLANT CONTROLLED OPERATING
in all
WISCONSIN
Air-Cooled
ENGINES

There's more to babbitting connecting rod bearings than simply applying the metal. Not only must the work be expertly done, but it is important that frequent detailed chemical analyses be made of materials in order to provide a dependable safeguard against inferior quality bearing metal, and to assure constant uniformity.

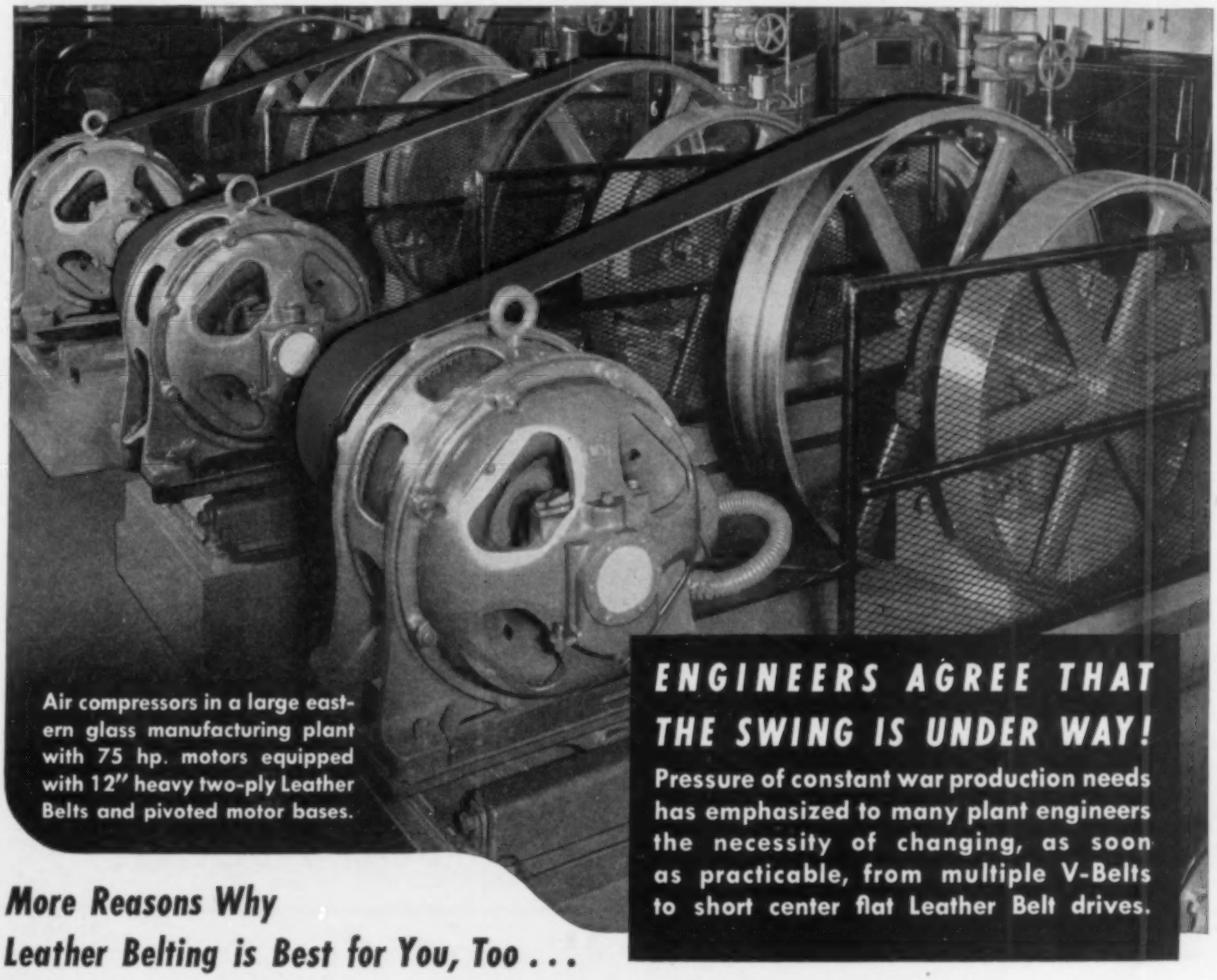
Wisconsin Engine connecting rod bearings are babbitted in our own plant, under our own complete control. A careful check is maintained to make sure that the metal is always what it *should* be and that it is applied *the way it should be*. This helps to make a better engine . . . designed to give better service on your equipment.

Most H.P. per pound

WISCONSIN MOTOR
Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

ONLY *Leather Belting* CAN DO THIS JOB PROPERLY

"INDUSTRY LEARNS BEST FROM EXPERIENCE"



Air compressors in a large eastern glass manufacturing plant with 75 hp. motors equipped with 12" heavy two-ply Leather Belts and pivoted motor bases.

ENGINEERS AGREE THAT THE SWING IS UNDER WAY!

Pressure of constant war production needs has emphasized to many plant engineers the necessity of changing, as soon as practicable, from multiple V-Belts to short center flat Leather Belt drives.

More Reasons Why Leather Belting is Best for You, Too . . .

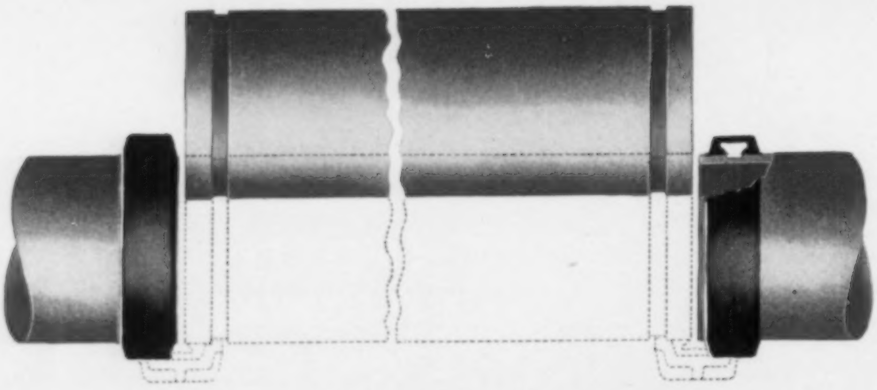
Plant operators are proving to their own satisfaction in many important cases that properly designed short center flat Leather Belt drives assure them longer belt life, less decrease in compressor capacity due to belt slip — and greater overload capacity than is possible with any other belt design or material. This is true because of the unique characteristics of Leather Belting in which the co-efficient of friction increases with the increased load, while its shock absorbing qualities protect the motor and compressor bearings.

YOU'LL HAVE FEWER SHUTDOWNS IF YOU STANDARDIZE ON SHORT CENTER FLAT LEATHER BELT DRIVES

AMERICAN LEATHER BELTING ASSOCIATION • 41 Park Row, NEW YORK 7, N.Y.

maintenance difficulties?

NEVER IN A VICTAULIC LINE...



because there is A UNION AT EVERY JOINT!

WAR BONDS
A PIPE LINE FROM
YOU TO HIM

Dismantle two joints anywhere in the Victaulic line ...and any individual *pipe length, valve or fitting requiring maintenance or repair can be quickly removed or replaced.* Adjoining sections are undisturbed ... pipe ends and couplings are uninjured.

This is an advantage in maintenance. But Victaulic advantages begin with the installation ... the speed and ease with which the couplings can be assembled ... the built-in flexibility of every joint, which eliminates accurate alignment and allows pipeline to follow the contours of the ground with a minimum of fittings ... the leak-proof and mechanical lock features ...

For full details, write for our new Victaulic Catalog and Engineering Manual ... Address VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y. Other Victaulic offices—Victaulic Inc., 727 West 7th St., Los Angeles 14, California; Victaulic Co. of Canada, Ltd., 200 Bay St., Toronto.

VICTAULIC

Reg. U. S. Pat. Off.

SELF-ALIGNING PIPE COUPLINGS
AND FULL-FLOW FITTINGS

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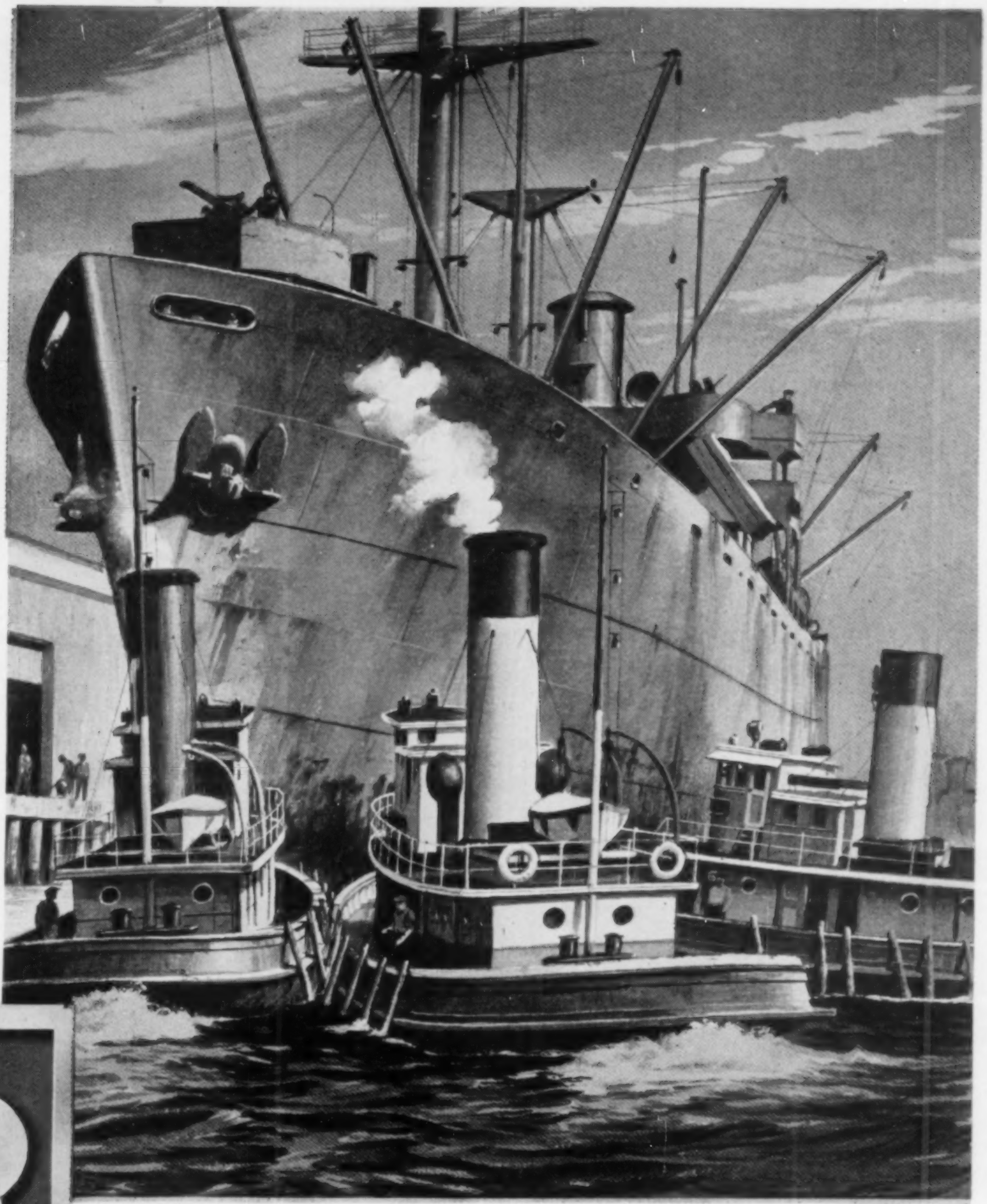
OIL MINING MARINE MUNICIPAL INDUSTRIAL



TEAMWORK.....

A machine that is more than adequate to do the job for which it was selected . . . a manufacturer with a continuing interest in the satisfactory performance of every unit shipped . . . a customer who solves his production problem with the best equipment he can buy . . . all work together for the successful accomplishment of the allotted task. ☆ Since 1871 Ingersoll-Rand installations have been telling just such a story of teamwork.

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TURBO BLOWERS
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AIR TOOLS
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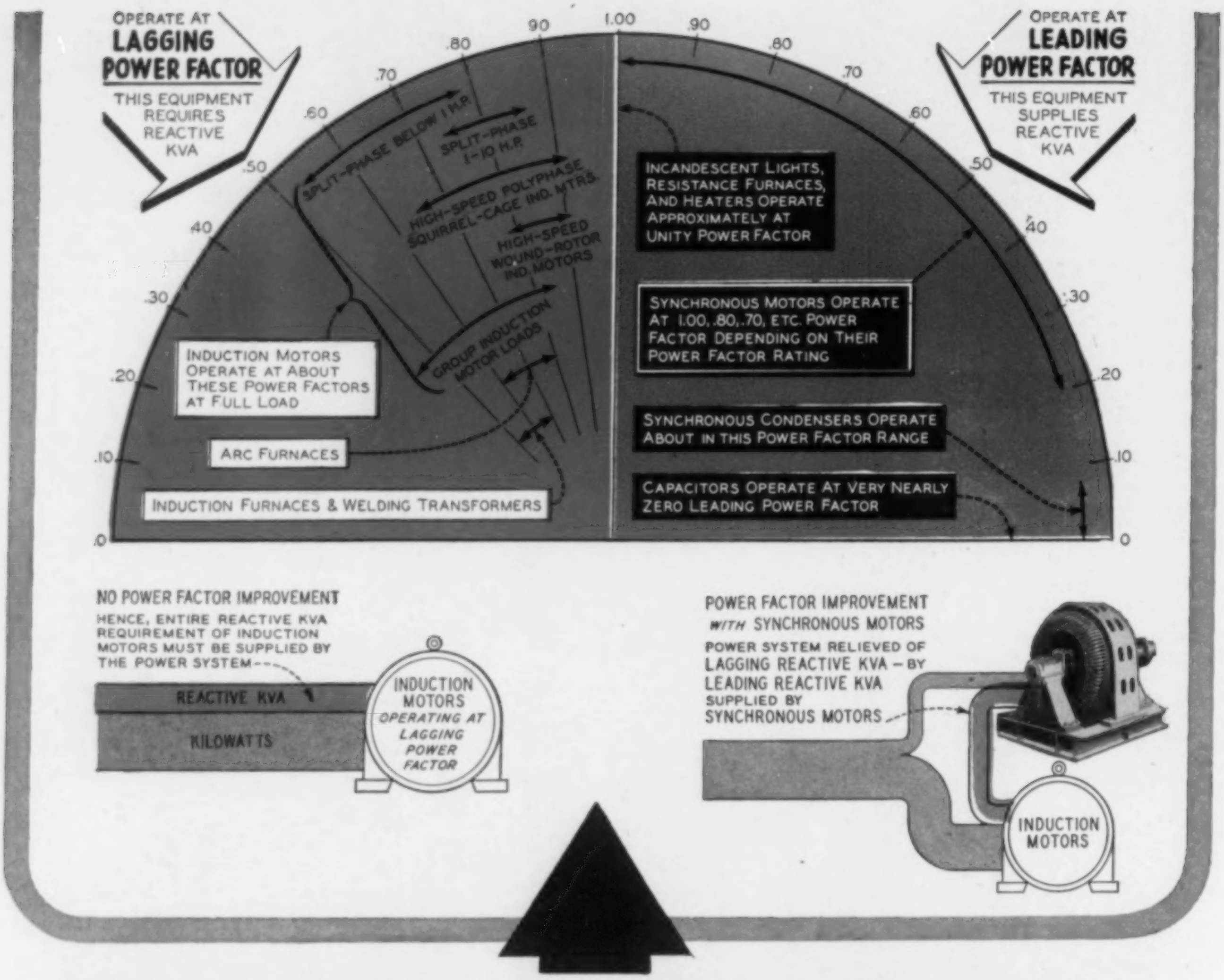
OPERATE AT
LAGGING POWER FACTOR
THIS EQUIPMENT REQUIRES REACTIVE KVA
OPERATE AT
LEADING POWER FACTOR
THIS EQUIPMENT SUPPLIES REACTIVE KVA
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.20
.30
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90
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.10
0
SPLIT-PHASE BELOW 1 H.P.
SPLIT-PHASE 1-10 H.P.
HIGH-SPEED POLYPHASE SQUIRREL-CAGE IND. MTRS.
HIGH-SPEED WOUND-ROTOR IND. MOTORS
GROUP INDUCTION MOTOR LOADS
INDUCTION MOTORS OPERATE AT ABOUT THESE POWER FACTORS AT FULL LOAD
ARC FURNACES
INDUCTION FURNACES & WELDING TRANSFORMERS
INCANDESCENT LIGHTS, RESISTANCE FURNACES, AND HEATERS OPERATE APPROXIMATELY AT UNITY POWER FACTOR
SYNCHRONOUS MOTORS OPERATE AT 1.00, .80, .70, ETC. POWER FACTOR DEPENDING ON THEIR POWER FACTOR RATING
SYNCHRONOUS CONDENSERS OPERATE ABOUT IN THIS POWER FACTOR RANGE
CAPACITORS OPERATE AT VERY NEARLY ZERO LEADING POWER FACTOR
NO POWER FACTOR IMPROVEMENT
HENCE, ENTIRE REACTIVE KVA REQUIREMENT OF INDUCTION MOTORS MUST BE SUPPLIED BY THE POWER SYSTEM
REACTIVE KVA
KILOWATTS
INDUCTION MOTORS OPERATING AT LAGGING POWER FACTOR
POWER FACTOR IMPROVEMENT WITH SYNCHRONOUS MOTORS
POWER SYSTEM RELIEVED OF LAGGING REACTIVE KVA – BY LEADING REACTIVE KVA SUPPLIED BY SYNCHRONOUS MOTORS
INDUCTION MOTORS

HOW SYNCHRONOUS MOTORS HELP REDUCE YOUR ELECTRIC POWER COSTS

By Keeping "Deadhead" Current Off Your Power System!

YOUR power supply has to provide two kinds of power: useful kilowatts that do work, and "deadhead" reactive kva needed for magnetizing induction motors and other inductive a-c equipment. Both must be paid for, though one's a *dead horse*.

Synchronous motors can help lick this problem. Because in addition to driving their mechanical loads efficiently and economically, they can also furnish *extra magnetizing kva to take care of inductive load requirements.*

This takes some reactive load off the power supply, which then has greater capacity for delivering *useful* kilowatts to your motors. Result: a higher power factor . . . which under many power rates assures substantial savings in power cost . . . and better motor performance in your plant because of improved voltage regulation!

Write today for "ABC of POWER FACTOR"

ELECTRIC MACHINERY
MANUFACTURING COMPANY
Minneapolis 13, Minnesota

Engineering and Sales Offices in 52 Cities
They Pay For Themselves By Power Factor Correction!
E-M
SYNCHRONOUS MOTORS
HIGH-SPEED
LOW-SPEED
M
ENGINE-TYPE
"PACKAGED"
A2012

BEWARE!

DON'T LET RUST RUN WILD WITH YOUR EQUIPMENT

LIKE SOME TERRIBLE PLAGUE, rust spreads its ruin everywhere.

Annually this thieving demon costs American Industry more than a billion dollars!

Until recently, rust has been accepted as a necessary evil in many operations.

Today, thanks to new developments, various types of rust-preventive coatings and lubricating oils are obtainable.

SHELL ENSIS RUST-PREVENTIVE COATINGS

As protection against rain and snow during outdoor storage, or high humidity conditions *inside*, Shell offers a complete line of Shell Ensis Rust-Preventives. These oils, fluids, and compounds come in various grades, each designed to meet a specific condition. Protective coatings range from thin transparent coverings that need not be removed, to coatings that resist extremes of weather over long periods.

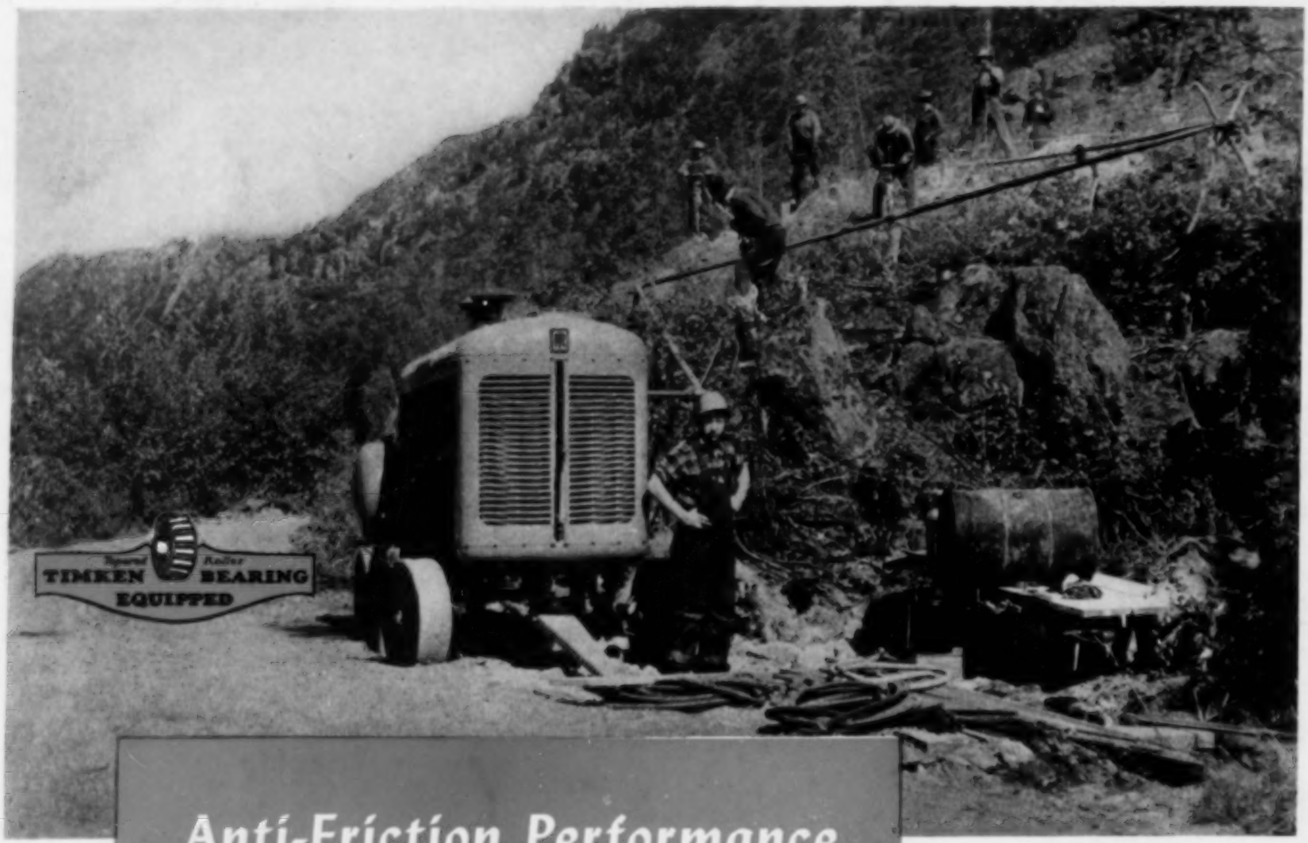
SHELL TELLUS RUST-PREVENTIVE LUBRICATING OILS

Where moisture is a factor, Shell Tellus Oils are recommended for machine lubrication. These scientifically developed oils cannot remove rust once it has started. However, because of special, built-in, rust inhibitors, they afford protection against the formation of rust—this without loss of lubrication qualities.

Call in the Shell man. He is a trained man, competent to study your operation and advise you. Let him show you how to keep rust out of your plant. Write, wire or phone—Shell Oil Company Inc., 50 W. 50th St., New York 20, N.Y., or 100 Bush St., San Francisco 6, Calif.

SHELL

SHELL LUBRICANTS FOR EVERY INDUSTRIAL USE



Ingersoll-Rand K-500 Mobil-Air Compressor operating jackhammers on the Alcan Highway.

Anti-Friction Performance is at its best in

TIMKEN BEARING EQUIPPED COMPRESSORS

Air compressors equipped with Timken Tapered Roller Bearings assure anti-friction advantages in full. That's why you should be sure to get them in every anti-frictionized compressor you buy—portable or stationary. To make sure, see that the trade-mark "TIMKEN" is stamped on every bearing.

It isn't only a matter of doing away with friction; equally important is ability to carry radial, thrust and combined loads; and to hold vital moving parts in correct and constant alignment.

Because Timken Bearings meet every anti-friction requirement fully and completely they have been used in Ingersoll-Rand Compressors for many years. Make I-R judgment your guide.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS